

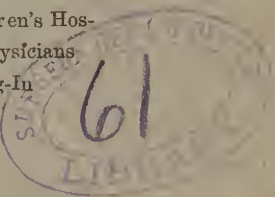
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# OCCLUSION AND DILATATION — OF — LYMPH CHANNELS

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### CHAPTER I.

#### Anatomy and Histology of the Lymphatic System.

Bibliography. Recklinghausen—Stricker's Manual of Histology. Klein—Anatomy of the Lymphatic System. Flint—Physiology of Man. Marshall—Outlines of Physiology. Kölliker—Manual of Human Histology. Gray—Descriptive and Surgical Anatomy. Dalton—Treatise on Human Physiology. Küss—Lectures on Physiology; translation by Armory.

The thoracic duct is, excepting those vessels which terminate in the right thoracic duct, the common trunk of the lymphatic vessels of the body, and is the channel through which the chyle and the mass of lymph reach the blood. Commencing at the receptaculum chyli upon the body of the second lumbar vertebra, it ascends between the aorta and vena azygos major, through the aortic opening in the diaphragm, into the thoracic cavity, to the fourth dorsal vertebra; thence, inclining to the left side, passes behind the aorta to the upper border of the

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NOTE.—This essay will only refer to the acquired forms. A paper by the author, entitled Congenital Occlusion and Dilatation of Lymph Channels, will appear in the "American Journal of Obstetrics," commencing with the number for January, 1877. In that essay will be found all the congenital cases. To avoid repetition, references will be made in each paper to points discussed in the other.

seventh cervical vertebra, and curving downwards from this point, terminates in the left subclavian vein, near the junction of the left internal jugular. At its beginning its diameter is about equal to that of a goose quill, diminishes in the middle of the thoracic cavity, and again enlarges before its termination. It is flexuous in its course, varicose in appearance, and is supplied with numerous valves, which are placed at shorter intervals in the upper than in the lower portion.

The right duct, about one inch in length and not exceeding a line and a half in diameter, receives the lymph from the right side of the head and neck, the right upper extremity, the right side of the heart, right lung, right side of the thorax, and from the convex surface of the liver. It terminates at the junction of the right internal jugular and right subclavian veins.

Each of these ducts is provided, at its termination, with a pair of valves with their free borders towards the veins. The left duct receives, at its commencement, several large trunks from the abdominal glands and also the trunk of the lacteal vessels, and along its course numerous connecting branches. Near its entrance into the subclavian vein it receives the trunk from the left side of the head and neck, and from the left thoracic extremity.

Each duct is composed of three coats: the internal consist of a layer of endothelium, resting upon an "elastic reticulated membrane, longitudinally fibrillated;" the tunica media is composed of transverse smooth muscle and transverse elastic fibres; and the adventitia consist of connective tissue, with elastic fibres and muscular fasciculi.

Connecting with these two central trunks, are two sets of vessels, which anatomists have denominated the superficial and deep-seated lymphatic vessels. The former are located in the subcutaneous tissue, accompanying the superficial veins, and in the sub-mucous and sub-serous tissues. The deep-seated vessels, fewer in number and larger than the superficial set, accompany the deep blood-vessels. Between these two sets of vessels, as between the vessels of each set, there is very free anastomosis, and by vessels of equal calibre with those connected, the continuous vessel remaining the same. But more properly, the entire lymphatic system should be divided into two sections; the first, in the language of Recklinghausen, containing the fluid, "immediately after it escapes from the blood-vessels, circulates

around the several elements of the organs, the interstitial spaces; and, secondly. the system of efferent canals, the proper lymphatic vessels." These efferent canals, agreeing ordinarily in form, arrangement, and structure with the blood-vessels, are only found in association with such vessels, being most abundant where the blood-vessels are most numerous. For the purposes of a more accurate description, these efferent vessels may be divided into capillaries, and the larger vessels which issuing from the several organs unite and form the main trunks.\* These larger vessels are provided with three coats: "the tunica intima [Recklinghausen], very rich in elastic fibres and lined by a single layer of tessellated epithelium; a tunica media, consisting exclusively of muscular elements; and a tunica adventitia, composed of connective tissue." The walls are thinner than those of the arteries, but are, in thickness, proportionate to their calibre, more like the veins. Like the thoracic duct, they are provided with numerous valves, usually semi-lunar in shape, formed by the duplicatures of the inner coat, and attached by their convex edges to the walls of the vessels, the free borders being in the direction of the course of the fluid contents.

Valves are less numerous in the vessels of the head and neck than in other parts of the body,† and more abundant in the superficial vessels, than in those situated between muscles, and are placed at shorter intervals in all the vessels the nearer they approach the glands. Usually there are two valves placed opposite each other, but there are many irregularities. Immediately above the valves the vessels are wider, which gives to the vessels, when distended with fluid, a "varicose or moniliform appearance."

Lymphatics are very abundant in the lungs; beginning in the walls of the air cells, they surround each lobule with a plexiform arrangement. More recent investigations (Schultze, Buhl, Rindfleisch,) have established the existence of a "lymphatic endothelium spread out upon the inner surface of the alveolar walls," and traced communication (Sikorsky) between the cavity of the alveolus and the lymphatic plexus existing in its wall, thus permitting the direct entrance of gases into the alveolar plexus of

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\* Flint divides the lymphatic system into three sets of vessels: the plexus situated on the general surface, the deep vessels, and the lacteals.

† Valves "are found more frequently in the lymphatics of the neck and upper extremities than in the lower."—Gray, *loc. cit.*, p. 482.



lymphatic vessels. The lymphatics of the lung (Buhl,) from their finest origin in the alveolar walls, follow the course of the bronchial arteries and run as interlobular, interstitial and peribronchial branches, to collect at last," either in "the sub-serous pleural envelope," or in the root of the lung.

In the ductless glands, in the liver, kidneys, testicles and ovaries, lymphatics are very numerous.

The lymph from the iris and ciliary processes is collected in the anterior chamber of the eye, and has its outlet through a channel communicating directly with the canal of Petit. "These passages, including the lymphatics of the conjunctiva and the canaliculi of the cornea," Schwalbe designates the anterior lymphatics of the eye.\* Lymphatics of the conjunctiva were discovered by Arnold and described by Teichman. Schwalbe doubts the statement of Lightbody, that the "capillaries of the corneal margin are surrounded by lymphatic sheaths."

Robin claims to have first recognized spaces around the vessels of the brain, and His, a peri-vascular canal system, which both observers described as lymph courses. Robin recognized an external boundary membrane, which he held to be the adventitia of the vessel, and maintained that the blood capillaries of the brain are partly surrounded by lymphatic sheaths, the coats of the latter being adherent to the walls of the blood capillaries; thus a portion of the wall of the latter is common to both kinds of vessels. His made the basic substance of the brain the outer wall of the lymph courses. Obersteiner, jun., failed to discover the adventitia described by Robin, and could only recognize as the external wall of the peri-vascular lymph courses the basic substance of the brain strengthened into a thickened zone. Roth insists that the radiating fibres, which form the wall of the vessels, traverse the lymph spaces and penetrate into the substance of the brain. His and Obersteiner hold that a communication does exist between the epicerebral space and the perivascular lymph courses, the latter claims to have filled the perivascular lymph courses from the epicerebral space, and, furthermore, to have demonstrated the existence of other tracks for the lymph, which consist in spaces around the ganglion cells of the brain, which he denominates pericellular lymph cavities. In the accompa-

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\* "Repeatedly already I have vindicated my far older claim from the year 1851 (this Archiv., Vol. viii., p. 445), but, strange to say, in vain." Virchow, Vol. lv., p. 318, Virch. Archiv.

nying figure he exhibits a portion of an injected perivascular cavity, upon which the only partly injected pericellular [Fig. 1] cavities hang like grapes upon their stem. An epithelium exists upon the inner surface of these lymph courses. Fleische demonstrated upon the surface of the brain, as well as upon the wall of the epicerebral space, a delicate membrane-cuticulum cerebri, and Obersteiner found, under certain conditions, in the lymph cavity, lymphoid corpuscles more or less numerous.

[Figure 1.]



Obersteiner\* believes that conditions similar to those described surrounding the ganglion cells exist in the medulla spinalis; "but that the adventitia of the vessels in the medulla spinalis possess a greater independence, so that frequently it is met with as an entirely free hollow cylinder, which floats towards the outside in the perivascular lymph cavity, towards the centre in a space, destined also, perhaps, for the lymph, and which surrounds the vessel proper."

The lymphatics of the uterus have their origin in the lymph spaces between the bundles (Leopold, Tilt) of the connective tissue frame-work of the lining mucous membrane, and in the inter-muscular connective tissue of the muscular structure. In the muscular layers both vessels and spaces are found most numerous in the external layer and along the larger blood-vessels in the other layers. Lymphatics are especially abundant in the cervix and in the muscular tissue about the internal os. The inter-muscular lymphatics are connected with the lymph spaces of the mucous membrane, and the vessels from the uterine tissues unite in the external layer, forming large channels on the sides of the body of the womb, which following the course of the blood-vessels, extend to the broad ligaments, and receive branches from the lymphatics of the ovaries, oviducts, cervix, vagina and labia. The labial lymphatics also send branches to the inguinal glands. The lymphatics found under the serous covering of the uterus are connected by anastomosing branches with those of the deeper parts, and form large networks which cover the anterior and posterior uterine surfaces,

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\*Virchow's Archiv, Vol. lv. 1872, p. 318.

the Fallopian tubes, and are provided with large varicosities about the insertion of the tubes. Championière has discovered one or more small glands in the midst of these lateral plexuses, situated nearly opposite the os internum. The lateral plexuses also communicate with the glands in the broad ligaments. The lymphatics of the unimpregnated womb are studied with very great difficulty, but they are so enlarged during pregnancy and certain morbid conditions of the pelvic viscera, that ample opportunities have been presented for tracing their anatomical distribution and connections.\*

The lymphatics of the skin (Biesiadecki†) consist of vessels and spaces—the latter being the tissue interstices which are filled with a serous fluid. The lymphatic trunks situated beneath the skin in the cellular tissue anastomose freely, and form under the corium a double network, one external to the other. The outer network lies beneath the external vascular capillary plexus, and the inner under the deeper blood vascular plexus. These lymphatic networks are connected by anastomosing vessels, and in the walls of the inner capillary network, elastic fibres are found. The connection of the serous interstices or lymph spaces of the corium with the lymphatic vessels proper has not been demonstrated. Neumann claims that the lymph capillary systems of the integument are closed canals without stomata, unconnected with open spaces, and that the inner plexus of lymph capillaries is supplied with valves and are abundantly supplied to the hair and sebaceous follicles, to the fat, to the sweat glands, and also richly distributed through the connective tissue. Biesiadecki denies that the papillæ of the skin in a normal condition are supplied with lymph vessels. Teichman, however, holds the opposite view, but admits that the central vessels of the papillæ in the normal skin, never reach entirely to the apex of the papillæ, sometimes forming only a slight projection into the bases of the papillæ, and at other places the lymph vessel extends half way the height of the papillæ, but that every papilla is not provided with a central lymph vessel. When found they are derived from the outer network. In the skin of an elephantiac leg he found, with few exceptions, the papillæ supplied with lymph vessels, extending generally from  $\frac{2}{3}$  to  $\frac{3}{4}$  their length, greatly enlarged, and usually dividing near the base of the

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\*See address by the author, Trans. Amer. Med. Association, vol. 27, 1876.

†Stricker's Manual, p. 546.

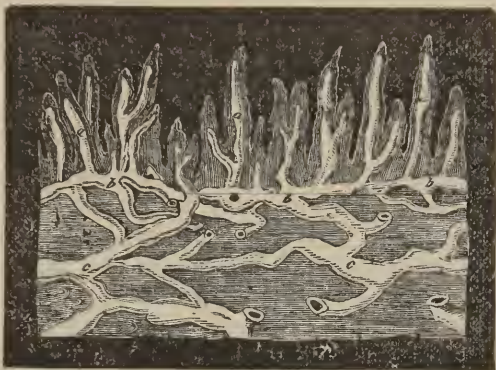


papillæ into two vessels, which emptied into the superficial network.

The accompanying cut [Fig. 2] (from Teichman\*) illustrates these conditions.

"Perpendicular section through the integument of the sole of the foot affected by elephantiasis: aa, the cul-desac-like starting points of the lymph vessels in the enlarged papillæ; b, vessels of external layer; c, vessels of internal layer. The vessels of the internal layer are collapsed, their dimensions are not therefore corresponding to their width."

[Fig. 2.]



Odenius, in a case of lymphorrhagic pachydermia, in which the vesicular formations were confined to the inner aspect of the left thigh, about six inches above the knee, found distinctly marked open ducts leading through the bases of the papillæ into the superficial lymph network, and beneath the surface of the cutis he found "wide, canal-like caverns or cavities," from which branches passed upwards towards the papillæ and downwards into the cutis. The arrangement of the lymph track differed from that given by Teichman, in that, a majority of the canals running deeper into the tissues, as well as a portion of those running horizontally, presented equal contours and a rounded form, while others possessed an irregular, angular, sinuous boundary, and a lumen irregularly enlarged. The exuded fluid presented all the characteristics of lymph, with an unusually large amount of fat. These observations of Teichman and Odenius,† so contradictory to the generally accepted opinion, that the skin papillæ are wanting in lymph vessels, suggest the inquiry whether the central lymph vessel of a papilla, when found, is a newly formed or preformed vessel. Odenius found the papillæ, for the most part, which did not participate in the

\* Das Saugadersystem, p. 62. Leipzig, 1861.

† Deutsche Klinik. 1874, p. 385.

vesicle formation, "small and without any sign of a cavity," even in their bases, but in certain isolated cases he recognized tracks or sinuses extending from the superficial lymphatic network more or less into the papillæ, which he claims represent the first stage of vesiculation, and corroborates the ordinary supposition that the central lymph vessels of the papillæ, when found, are newly formed vessels, and insists that the "horizontal canals which pass upwards towards the papillæ are mere excavations in the tissue, and not dilated preformed vessels." The lymph spaces acquire a free communication with the lymph vessels proper and afford efflux to the advancing fluid, which as the dilatation of the cavities progresses through the papillæ, forces its way into the epidermis and collects into vesicles. In this manner Odenius would account for the varying development of the central lymph vessel of a papilla, sometimes extending entirely through a papilla and terminating in a vesicle, at other places simply presenting a pouch-like projection into the base, the differing gradations of development depending upon the duration of the morbid process.

It cannot be doubted that the vesicle formations in the case of Odenius were directly connected, through open canals, with the lymph vessels, for the vesicles characterized themselves as true lymphangiectasiæ, and the exuded fluid exhibited chemically and microscopically the unmistakable and essential constitution of lymph, but it cannot be maintained that all vesicle formations, even when presenting all the evidences of a lymphatic origin and connection, are the terminal, ampullar dilatations of newly formed vessels, which have, by a gradual and continuous development, penetrated the skin papillæ, or that they bear any anatomical relation whatever to the papillæ. In many cases, perhaps in most, they are true ectasiæ of the vessels of the superficial network of lymphatics.

The lymphatics are very delicate vessels, with walls very distensible and so translucent that the contained fluid can be easily seen. They are very variable in structure and arrangement, even in different parts of the same animal. Variability is, however, more frequent in the capillaries, which in man are tubular, and occasionally provided with sacciform dilatations, which are sometimes so arranged as to form a kind of valve.

Sømmerring and others of the older anatomists insist that the

tubular system of lymph vessels is proportionally larger in large animals; that is, that they are necessarily larger in a giant than in a dwarf. Sappey, however, maintains that the lymph ducts are proportionately larger in the infant than in the adult, and Jacobi (*Am. Jour. Obs.*, vol. ii. p. 653) claims they are larger and more numerous in the child.

The investigations of Recklinghausen and Klein have, perhaps, finally determined the structure and mode of development of the capillary lymphatics. Various opinions have been advanced in regard to the existence of a limiting membrane. Brücke formerly held that the central chyle capillaries did not possess any limiting membrane, and Kölliker (*loc. cit.*, vol. ii., p. 3) held that a structureless investing wall did exist. Frey and Teichman maintain that the lymph capillaries are completely closed. More recently, however, Frey has claimed that the lymph capillaries, unlike the blood capillaries, are fused with the surrounding tissue. Recklinghausen has demonstrated the presence of a tessellated epithelium in lymph channels, but denies the existence of a special wall in the open interstices to which he traces the origin of the capillaries.

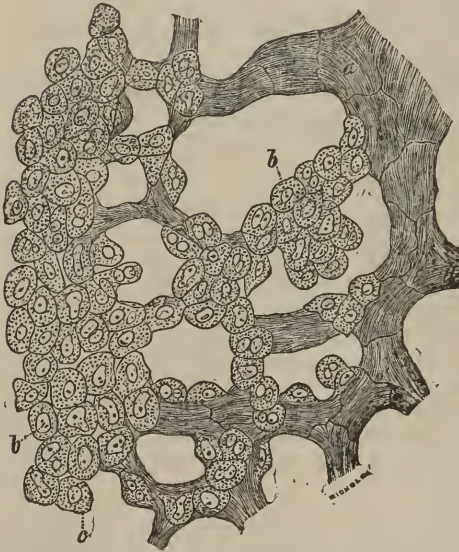
The recent investigations of Klein into the anatomy and histology of the lymphatic system of the serous membranes are so interesting and instructive, and bear such an important relation to the study of the nature and pathology of various affections of the lymphatics, that I must be pardoned for attempting to reproduce his views and conclusions.

In his description of the endothelium of the free surfaces of the serous membranes, Klein dissents from the generally accepted opinion, that it is simply a layer of flattened more or less hyaline cell plates, and holds that in many places there may be found, more especially upon the larger trabeculæ which contain blood-vessels and fat tracts, individual cells and varying-sized groups of cells, polyhedral, club-shaped or columnar, possessing a granular substance, a nucleus either constricted or divided, and a large shining nucleolus. These forms of cells Klein denominates young or "germinating endothelial" cells, to which are usually attached, by a protoplasmic stalk, cells with a divided or constricted nucleus, and also other cells, not unlike lymphoid cells; attached or in process of separation.

"The accompanying figure [Fig. 3], from a silvered preparation

of the fenestrated portion of the omentum of a guinea pig suffering from chronic peritonitis," exhibits at a, thin trabeculæ covered

[Fig. 3.]

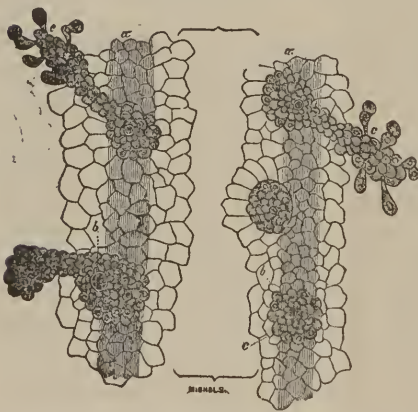


with common flat endothelium; b, abundant germination of endothelium, springing off from the surface of a larger trabecula, c, and continuing on the smaller trabeculæ. (From Klein, fig. 13.)

These germinating cells are sometimes provided with cilia, and have been observed to perform amœboid movements; they proliferate with marked rapidity, and produce in great abundance lymphoid cells. Occasionally they present the appearance of

granular, bud-like bodies, springing from the common endothelial plates.

[Fig. 4.]



[Fig. 4.] "Peritoneal surface of a silvered preparation of a centrum tendineum of a guinea pig which suffered from chronic infect. peritonitis (artificial tuberculosis). (From Klein, fig. 8.) a a a a indicate the straight lymphatic vessels between the tendon bundles; b represents stomata which are plugged up by a substance which has become darkly stained by the reagent (fibrinous

plug); the endothelium which surrounds the stomata is in a state of intensive germination, forming buds and villi, freely



projecting over the surface; on the latter ones cells are seen to be in the state of detaching themselves by constriction (lymphoid cells).

The cells of the common endothelial plates do not always touch each other. In such places, with its body filling the interspace and its processes stretching between the individual cells, are found branched cells, varying in size, shape, and in the character of their nuclei and processes. Sometimes the body of the branched cell lies beneath the endothelium and stretches its granular processes between the superficial cells.

[Fig. 5.] "From a silvered preparation of a pencilled mesentery of an ape suffering from chronic peritonitis (Klein, fig. 19). M, connective tissue matrix not represented; a, the lymph canicular system, with its corresponding branched cells; b, large migratory cells which lie in the l. c. system beside the branched cells.

[Fig. 5.]



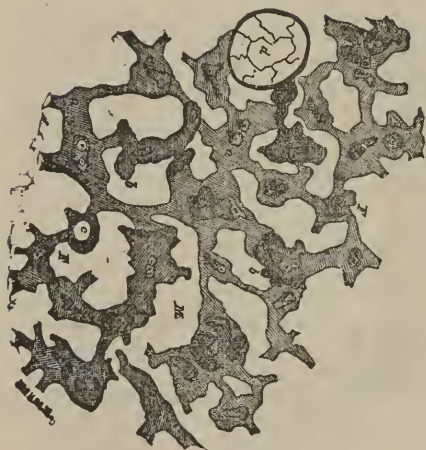
It is, however, in the structural organization of the ground substance of serous membranes that the important histological relation of the branched cells to the lymphatic system is to be correctly and definitely traced. In the omentum of the rabbit are found isolated opaque patches, and opaque tracts variable in size and formed by the coalescence of patches, and forming, by intercommunication, a network. These tracts, to which other patches are laterally situated, usually follow the course of the larger blood capillaries. Isolation of patches belongs to youth, confluence advances with age. Hence there is continuous new formation of patches and a continuous coalescence into tracts. In the patches, whether confluent or isolated, however small, are recognized brownish structures which contain larger or smaller brownish granules, an ovoid sharply outlined nucleus with a nucleolus, or a constricted nucleus, or a few small nuclei.

[Fig. 6.] "From a pencilled silver-stained normal omentum of



a rabbit, representing a young patch, the ground substance of which, M, is unstained. (Klein, fig. 30.)

[Fig. 6.]



"a, The lymph canalicular system, with the corresponding branched nucleated cells.

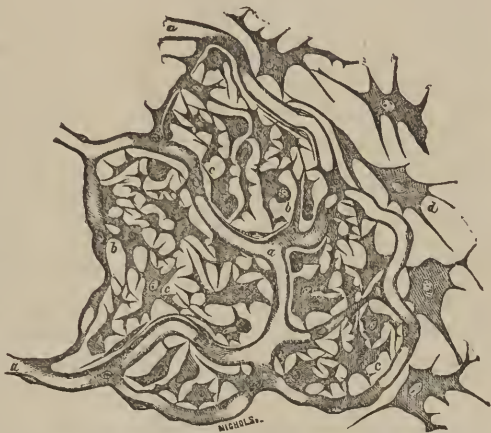
"b, Migratory cells, either perfectly detached from those branched cells or in a state of growing from them.

"c, Vacuolated element, which is a mere knob of a branched cell. In a, the vacuolation has gone so far that a vesicle is formed, the wall of which has differentiated in endothelial plates, (development of a lymphatic vessel) at F division of the branched cells."

These brownish cells are irregular in shape and size, with bodies beset with blunt prominences, always larger than white blood corpuscles, but resembling migratory cells in shape. There are also to be found in such patches granular corpuscles, with one or two nuclei, and very like lymphoid cells, in some places resembling knobs in process of separation from the brownish cells. Besides these cell elements, the ground substance is occupied, to a greater or lesser extent, by a finely granular (a, fig. 6) network, which consists of plate-like enlargements (represented by the granular parts of the figure), containing a nucleus with one or two nuclei, or a constricted or divided nucleus. This network represents the branched cells of the ground substance connected by their granular protoplasmic processes, some of which are in process of division (as at F), and from which grow (b) other granular elements. A young non-vascularized patch is made up of its connective tissue matrix (M) and granular protoplasmic branched cells, with their cell-element contents. In a vascularized patch nearly the entire "matrix is occupied by a network of finely granular nucleated cells (c, fig. 7), which network is in communication with the isolated branched cells (d, fig. 7).

[Fig. 7.] "From a silver-stained preparation of normal omentum of a rabbit, representing a vascular patch, the ground substance of which has remained unstained, whereas the very rich network of the branched cells (c) has become very distinct. (Klein, fig. 29.)

[Fig. 7.]



"a, Capillary blood-vessel. At b, their connection with the branched cell of the ground substance; these places represent at the same time where young capillaries are formed. c, Branched cell of the matrix; d, similar ones of the ground substance of the neighborhood of the patch."

In such a vascularized patch, when the connective tissue matrix is stained and the branched cells are unstained, a system of clear lacunæ, communicating by finely granular branched or unbranched canaliculi, becomes apparent: the lacunæ represent the spaces in which lie the branched cells and lymphoid corpuscles. The ground substance of serous membranes is thus mainly composed of finely granular nucleated protoplasmic cells—the lymph canalicular system of Recklinghausen, the bodies of the branched cells occupying the lacunæ and their processes the canaliculi.

Sometimes there are superficial groups of lacunæ, or rather of branched cells, resembling groups of endothelial plates branching out. There may also be found patches, more or less vascularized, in which the matrix, besides containing a few lymphoid cells, is nearly supplanted by branched cells crowded together, which is, perhaps, the result of multiplication by constant division—thus contributing to the growth of the patch. Such patches are not unlike the others in structure, but are farther advanced in the process of development. Another variety of patches consists in a network of capillary blood-vessels, between which are a number of lymphoid corpuscles held together in a reticulum of

branched cells, similar to the reticulum of adenoid tissue. The lymphoid cells, which lie with the branched cells in the lymph canalicular system, and which are found in all sizes between a rounded nucleus surrounded by "a zone of protoplasm up to cells which are twice as large as a colorless blood corpuscle." are derived from the branched cells of the ground substance.

It thus becomes manifest, that in the omentum of the rabbit there are found two lymphangial structures.

"1st. Patches, the matrix of which consists of groups of ordinary, more or less flattened, more or less branched cells, which on the one hand multiply by division, in which way the patch increases in size, and from which, on the other hand, grow up lymphoid cells. The branched cells lie in the lymph canalicular system, together with the lymphoid cells. At an early stage of development these patches do not contain a special system of blood capillaries; at a later period they possess a special rich system of mostly capillary blood-vessels. By growing in length these patches join so as to form whole tracts."

"2d. Patches and tracts, the matrix of which consists of a reticulum, the meshes of which contain a variable number of lymphoid corpuscles; they are generally provided with more or less abundant blood-vessels."

Similar structures are to be found in the omentum of the guinea pig, cat, dog and monkey, which in like manner form tracts, which, by growing in thickness, form nodules, and by coalescence, cords, the larger ones being provided with blood-vessels, and may either follow the course of the blood-vessels or be isolated. As in the omentum of the rabbit, the ground substance contains more or less branched cells, with oblong nuclei, which in some nodules are crowded together and joined by shorter or longer processes, forming a network and corresponding to the lacunæ of the lymph canalicular system. The nearer the cells are to the border of the tracts or nodules, the more they are branched; consequently, in the central part of a nodule the lacunæ may communicate by very short canaliculi, corresponding in length with the protoplasmic processes, or may touch each other. Sometimes nodules are found elongated and consisting of a reticulum of branched cells, the meshes of which are filled with lymphoid corpuscles; and, finally, nodules are found with a rich system of blood-vessels, between which is found a reticulum of branched cells, the meshes of which are filled with

a fluid, or with lymphoid cells either separated or growing from the branched cells.

In all these nodules, as in the tracts in the omentum of the rabbit, are found migratory cells, either resembling lymphoid corpuscles, or which are large and coarsely granular; sometimes having a distinct continuance with the branched cells; sometimes growing up like knobs and becoming separated from the branched cells; sometimes the nucleated knob projects from a reticulum of branched cells, or is only raised from the branched cell by a more or less deep furrow, or is connected with it by a thin peduncle; and, again, the meshes of a reticulum of branched cells may be filled with lymphoid cells. From these observations Klein concludes that the lymphoid corpuscles are the offspring of the branched cells. These views differ from those of Knauff and Recklinghausen, in that the lymphangial tracts and nodules are not mere accumulations of lymphoid corpuscles; and from those of Burdon Sanderson, in that they are not mere tracts of adenoid tissue.

The anatomical relation of the lymphatic and blood capillaries is peculiarly interesting. The very beautiful delineation by Recklinghausen seems adequate to the fulfilment of all the requirements of normal nutrition, and furnishes very ready and plausible explanations for very many obscure and apparently inexplicable morbid phenomena, but in view of the more recent researches of Klein, his demonstration cannot be accepted as complete and entirely satisfactory. Recklinghausen (Stricker, p. 218) says, the larger lymphatic vessels are always situated in close proximity to the blood-vessels, whereas the capillaries are located in the meshes of the blood capillaries—thus most remotely located from the latter. This arrangement, he insists, subserves to the fullest extent the purposes of drainage; for as the fluid from the blood capillaries must reach the lymph capillaries, it follows that it must traverse the entire tissue; hence every part of the intervening tissue must be washed by the fluid flowing towards the lymphatic capillaries, and thus a constant interchange of fluid is going on. If, on the contrary, the two classes of capillary tubes were in immediate proximity, no such constant current and interchange of fluid could take place through or about the tissue elements, and stasis might occur in the remote parts. And furthermore, in the mucous and serous membranes, and in the skin, the lymph capillaries occupy a



deeper locality than the blood capillaries; in the villi of the small intestines the chyle capillaries lie in the central axis, while the blood capillaries lie in the peripheric tissue layer; and Teichman has shown that the lymph capillaries lie in the centre of the papillæ of the cutis, while the blood capillaries are upon the periphery, just beneath the epithelium.

Klein has very minutely investigated the anatomical relation of these vessels in the serous membranes, but does not suggest that there is any absolutely invariable or uniform arrangement. He describes the lymphatics in the omentum and pleura-mediastini of the rabbit as sometimes coursing along both sides of groups of blood capillaries, and again, running independent of such vessels; in the latter manner chiefly in and about lymphatic patches. When accompanying blood-vessels they are much larger, have a sinuous endothelium, possess valves and a corresponding sacculated dilatation. When coursing apart in the tissues, though not unlike the others in calibre and having a sinuous endothelium, they are without valves, but provided with sinus-like dilatations. This latter class only does he regard as capillaries. In some places a single lymphatic, usually of that variety having a sinuous endothelium, may be accompanied on both sides by a vein, and occasionally, also, by an artery, or the blood-vessel may run between two lymphatics, which connect by anastomosing branches. Recklinghausen refers (*loc. cit.*, p. 217) to a form of "lymph tubes accompanying blood-vessels, and not unfrequently with regular sheaths, which partially or wholly surround them." Klein describes three varieties of invaginating lymphatics. In one form the vein and its branches are included up to its entrance into a larger trunk; in a second form, the vessels separate before reaching the larger trunk; and in the third form, the invaginating lymphatic very suddenly acquires an extensive dilatation, through which the blood-vessel penetrates.

[Fig. 8.] "Silver preparation of a pencilled omentum of a rabbit. (Klein, fig. 40.)

"a, Capillary blood-vessel.

"c, Lymphatic capillary vessels showing endothelium; the blood-vessels are invaginated in these lymphatics.

"d, Branches of the lymphatic vessel, which are in communication with the lymph canalicular system of the ground substance.



"f, The lymph canalicular system of a lymphatic patch, which system is also in communication with the lymphatic vessel at g."

Figures 8 and 9 exhibit other forms of invagination.

[Fig. 8.]



The relation which the blood-vessels bear to the lymphatics in the structure and formation of lymphangial nodules and tracts is also peculiarly interesting. Those tracts and nodules resembling adenoid tissue, and those vascularized nodules and tracts in which the spaces of the matrix are subdivided by a reticulum of branched cells, the meshes of which are filled with a fluid containing a few lymphoid corpuscles, are developed within the lymphatic vessels, and denominated endolymphangial nodules or tracts. Such perivascular lymphatics present themselves in one or more forms; as a large tube, with sinuous endothelium, including a portion of a vein, and terminating in a sacciform dilatation which includes the venous and arterial capillaries, thence losing itself where the artery ceases in a lymph canalicular system, which accompanies the artery; or such lymphatic tube accompanies a vein and terminates in a blind sacciform dilatation, in which the venous capillaries hang like "the glomerulus of a malpighian corpuscle of the kidney." The latter form is the more frequent, because lymphatics more frequently accompany than invaginate a vein. The outer wall of all invaginated blood-vessels has an endothelial covering, resembling the endothelium of the lymphatic capillaries.

[Fig. 9.] "Fresh preparation of an œdematous omentum of a guinea pig suffering from chronic peritonitis. (Klein, fig. 43.)

"a, A venous capillary vessel filled with blood.

"b, An invaginating lymphatic vessel.

"c, Outer endothelial wall.

"e, Inner (covering the blood-vessel) endothelial wall of the lymphatic vessel.

[Fig. 9.]



"d. Endolymphangial reticulum, which is continuous with the endothelial wall of the lymphatic vessel. In this way endolymphangial nodules and tracts are formed."

In the angle formed by the bending of the vein (fig. 9) and between the wall of the lymphatic (c) vessel and the outer wall of the vein (e), is a reticulum formed by branched cells connecting the walls of the blood and lymphatic vessels, which exhibits the mode of formation of an endolymphangial tract or nodule, which may grow and extend, even beyond the walls of the lymphatic, into the surrounding tissue, and become richly supplied with a blood capillary system.

[Fig. 10.] "From same omentum as fig. 9. (Klein, fig. 50.)

[Fig. 10.]



"a, Vein.

"b, Artery.

"c, Capillary.

"d, A lymphatic vessel, in which the whole system of blood-vessels is invaginated.

"e, Reticulum of nucleated branched cells growing from the endothelial wall of the lymphatic vessel into the cavity of the vessel."

The capillaries lie in a lymph sac, in which (e) is seen branched protoplasmic bodies extending from the endothelial outer wall of one capillary to the wall of another and neighboring capillary, forming a reticulum resembling adenoid tissue, in the meshes of which lie lymph corpuscles.

Thus the lumen of a sac or of a vessel may be divided into a number of spaces and finally be transformed into a cavernous or sinuous structure.

Those nodules, tracts and cords, which are formed by the simple accumulation of germinating endothelium on the surface, and by the accumulation of lymph canalicular systems, are developed outside of lymph vessels, and denominated perilymphangial structures. The accumulation of lymph canalicular systems may be formed by the joining together of the lacunæ, or by the fusion of groups of the spaces of the lymph canalicular systems.

It thus appears that some parts of the free surfaces of serous membranes are covered with germinating endothelium, and other parts with lymphangial structures corresponding with the cortical and medullary portions of lymphatic glands. In each of the parts lymphoid or white blood corpuscles are developed, and consequently serous membranes may be regarded as blood-producing organs.

The important question now presents itself, what relation do these tracts, nodules and cords, bear to the lymphatic vessels? Do the tubular vessels terminate cæcally, or communicate directly with the tissue interspaces? Virchow and Donders have advanced the theory that the stellate connective tissue corpuscles, which are intercalated between the blood and lymph capillaries, constitute the channel of the fluid transuded from the arterial capillaries. Mascagni, and since, Fohmann concluded that the tissues were composed entirely of lymph vessels and connective tissue trabeculæ. This view Brücke also maintains. Recklinghausen traces the lymph capillaries to the serous canalicular spaces which traverse the masses of connective tissue and form direct communication with the tubular vessels; and, though not provided with a special wall, are not mere fissures between the components of the tissues, but the interstices of the fibrous fasciculi. The capillary vessels (Recklinghausen) begin where the epithelial lining commences. Kölliker traced the lymphatic capillaries to cæcal terminations, which send out prolongations ultimately connecting with similar prolongations from formative cells. Neumann insists that the lymph capillaries of the integument are closed canals, unconnected with the intercellular connective tissue spaces. Whatever differences of opinion exist, all histologists are agreed that the origin

of lymph vessels is in intimate relation with the connective tissue cells and fibres. Klein's researches are much more satisfactory. He traces the blood and lymph capillaries to the nucleated branched cells of the lymphangial structures, but maintains that the two processes of development are essentially different.

The lymphatic capillaries are formed by the vacuolation and vesiculation of the branched lymph canalicular cells and of the buds which spring from (fig. 6) these cells. In every such nodule or patch there are found a number of vacuolated cells and vacuolated buds springing from branched cells (c, fig. 5; b, fig. 7), in which the vacuolation continues to increase until the protoplasmic body is transformed into a vesicle (d, fig. 6) which finally becomes distinctly differentiated by endothelial cells. These vesicles may arrange themselves in groups or in linear series, or may become connected by protoplasmic process, corresponding with the processes of the branched cells, and, either by fusion or by the extension of the process of vacuolation through the connecting processes, unite with each other; and by similar vacuolated processes communicate directly with the lumen of an existing capillary vessel—thus extending the tubular system of vessels, or forming sinuses and dilatations by lateral connections with the walls of existing capillaries. Hence "there can be no doubt whatever . . . that the lymphatic vessel . . . loses itself (Klein, *loc. cit.*, p. 36) in reality in a labyrinth of spaces, which consists of lacunæ with uniting canals, representing the lymph canalicular system, and, that the endothelial plates of the lymphatics are continued as branched cell plates." Klein thus accepts the views of Recklinghausen, adding the fact of the continuity of the endothelium of the tubular system with the endothelium of the canalicular system, and traces the direct connection of the two systems through the fusion of the endothelial vesicles, which are formed by the conversion of the canalicular system.

Kiüss erects the lymphatic system into a cone, with its summit at the left subclavian vein and its base at the epithelia, and considers the loose cellular tissue as a "vast chambered lymphatic sac, communicating directly with the lymphatic vessels." It seems generally conceded that the lymphatics communicate with lacunæ of the connective tissue, but it is yet in doubt whether their origin is intracellular or intercellular. Virchow traced their ultimate termination in the connective tissue cor-



puscles or plasmatic cells, which probably correspond with the lacunæ of Recklinghausen.

The walls of newly-formed blood capillaries are protoplasmic, and the vessels are formed (Klein) from previously existing capillaries by continuous excavation of the branched cells attached to their walls (fig. 7), and, also, from isolated lymph canalicular cells by vacuolation and immediate fusion with the lumina of capillary vessels. The vacuolation does not, however, proceed to vesiculation, but elongates towards existing capillaries or branches in process of hollowing out.

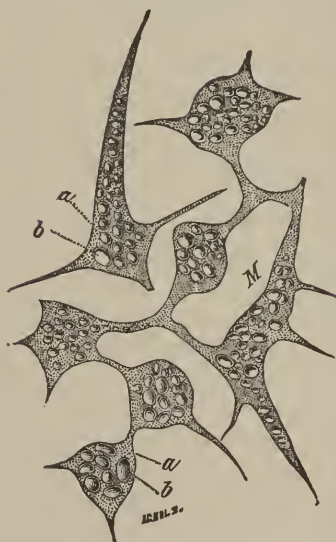
Notwithstanding the formation of both systems of capillary vessels is traced to developmental processes originating in the branched cells, which are also engaged in the production of lymphoid and white blood corpuscles, Klein does not claim any direct communication between the two systems of capillaries. Recklinghausen, however, considers "it very possible (*loc. cit.*, p. 232) that the serous canals may stand in the same open continuity with the blood-vessels as with the lymphatics." Views somewhat similar have been advanced by Virchow, Kölliker, and Arnold, though recently Tarchanoff has denied any such communication. Assuredly such a communication has not been demonstrated, but many circumstances indicate the ultimate confirmation of Recklinghausen's suggestion.

Klein regards the perilymphangial structures as the analogues of the fat tissue, and traces the similarity in structure and development of the fat tissue and the perilymphangial structures. He insists that the branched cells of the vascularized tracts and nodules may be transformed into fat cells, and that the tracts and nodules may be converted into fat tracts and fat nodules, but that the fat tracts and perilymphangial structures stand in opposite relation to each other, that is, the greater the number of the latter the fewer the fat tracts, and vice versa. Nor is this tendency of the lymphangial structures to be converted into fat tissue uniform in all animals or in different serous membranes of the same animal. Differing with other histologists, he maintains that the transformation of the lymphangial structures into fat tissue is not by conversion of the lymphoid cells, which are in part the offspring of the branched cells of the matrix, but that the fat cells are transformed branched cells; and, consequently, with the increase of the number of fat cells



there occurs a marked diminution in the number of lymphoid cells.

[Fig. 11.]



[Fig. 11.] "From the mesentery of an ape suffering from chronic peritonitis. (Klein, fig. 21.)

"a, Enlarged branched cells of ground substance, filled with fat globules b.

"The ground substance M is not represented."

The nourishment which is normally provided for the production of lymphoid cells is consumed in the formation of fat cells, and this consumption of the nutrient material may progress so far as to arrest the development of lymphoid cells, and no lymph corpuscles would be conveyed through the lymphatic vessels.

When this transformation is going on the nodules grow faster, and the blood capillary system is more actively developed. These observations differ in many essential features from the views of Rollet (Stricker, p. 32). The latter investigator regards the fat cells as transformed young cells and the fat tissues as simply the deposition or accumulation of fat cells in the connective tissue, the separate groups or lobules being divided by strong trabeculae, and insists that the new formation of adipose tissue is always associated with an increased supply of nutrient material—such new formation being invariably preceded by a marked proliferation of young cells.

It remains yet to consider the relation of the lymphatic vessels to the surface of the serous membranes. Klein and Recklinghausen hold that all serous cavities, like the peritoneal, possess an intimate connection with the lymphatic tubular vessels; in fact, that they are sacs with surfaces studded with stomata-openings through the walls of capillaries, and the mouths of lymph channels which connect directly with the lumen of superficial lymphatic vessels. (See fig. 4.) Schweiger-Seidel and Dogiel, found similar openings in the cisterna lymphatica.

ticæ magna of the frog. Dybkovski has demonstrated them in the pleura of the dog, and Recklinghausen and others have witnessed globules of milk penetrating the walls of the lymphatics of the central tendon of the diaphragm. Flint emphatically denies the existence of any such openings. Klein recognizes two kinds of stomata—stomata vera and stomata spuria. The vera may either be vertical channels lined by endothelium and communicating directly with the lumen of straight lymphatic capillaries, or may simply represent a discontinuity between the surface endothelium and lead into a superficial lymphatic sinus. Both of the above forms are bordered by germinating endothelium. (See fig. 4.) As has been previously stated, there are to be found branched cells occupying the spaces where the endothelial cells of the surface do not touch each other, and also beneath the surface endothelium, sending out their protoplasmic processes between the individual cells and between the groups of cells. As these branched cells lie in the lymph canalicular system, it necessarily follows that this system opens on the surface. Such openings represent the pseudo stomata. These also are lined by germinating endothelium (see fig. 4), possessing a marked tendency to produce bud-like processes, which project over the surface.

The lymphatic follicles "are small spheroidal bodies of the size of millet seed," situated within the mucous and sub-mucous tissues of the digestive tract, and in the spleen and lymphatic glands. The follicular or adenoid tissue is composed of a reticulum and adherent lymph corpuscle-like cells, the reticulum being formed into a close network, the meshes of which are contained a few corpuscle-like cells. The cells constitute the greater part of the adenoid tissue, and when separated flow away in the milky fluid. The peripheric fibrils of the reticulum connect with the intercellular substance of the surrounding connective tissue, and attach themselves also to the blood-vessels and capillaries which traverse the follicles. The relation of the lymphatic vessels to the follicles has not been determined. The follicles of the digestive tract are invested with a network of these vessels, but none have been demonstrated in the interior of the individual follicles, which seem to lie in lymph sinuses formed by the coalescence of some of the vessels of the surrounding plexus of lymphatic vessels. The follicles are supposed to form lymph cells, which ultimately constitute lymph corpuscles.

The lymphatic glands are small solid bodies, varying in size from a hempseed to that of an almond, are of a round or oval form, and situated in the course of the lymphatic and lacteal vessels. They are found in great numbers in the mesentery, in the mediastina, and along the larger blood-vessels in the abdomen. The variability in the structure of the lymphatic system is especially manifest in the glandular bodies.

The gland substance is divided into a cortical and medullary portion, but there is no essential difference in the structural organization of these portions.\* More properly the gland substance is composed of follicular tissue, trabeculæ and lymph tracts. The trabeculæ are prolongations of the gland sheath and continuous with the connective tissue of the hilus. In the peripheric portion they are more widely separated than in the central, and, in conjunction with the sheath, form alveolar-like spaces uninvested towards the hilus. As the centre is approached the trabeculæ approximate more closely, thus diminishing the invested spaces, and communicate more freely. The follicular tissue is usually formed into cord-like masses, and consist of a reticulum enclosing lymph corpuscles. The cortically situated portions are simple club-shaped dilatations of the medullary substance, differing from the latter in being more compact, with fewer and smaller lymph spaces. In the medullary substance the cells are densely packed, more distinctly fixed, and not easily washed out with the natural lymph current.

No doubt exists in regard to a channel communication between the afferent and efferent vessels, though not by distinctly formed tubular vessels, but through a complex system of lymph paths, which communicate more directly and distinctly with the afferent than with the efferent vessels. The afferent vessels are distributed on the surface of the gland, and open into lymph sinuses, formed on the superficies of the alveolar trunks by the spaces between the follicular framework and the trabecular system. The rootlets of the vasa efferentia are moniliform, communicate very freely, forming a cavernous structure, the separate vessels of which are very short and are supposed to connect with the lymph paths of the medullary substance. Recklinghausen describes the relations of the several parts, by supposing a "rete mirabile to be introduced between them, the several

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\* Recklinghausen, loc. cit., p. 235.

branches of which suddenly diverge from the extremity of the afferent vessel, and then proceed to divide and subdivide, becoming consequently more attenuated. These finer branches perforate the intervening layers of tissue in all directions, freely anastomosing with one another, and finally suddenly reunite in the extremity of the continuous and tubular efferent vessel. The follicular substance is chiefly developed in the dilatations near the point at which the vasa efferentia are attached, and from this point become gradually more and more attenuated, till it loses itself on the lymph path at the borders of the medullary substance."

The blood-vessels are, properly speaking, only distributed in the follicular cords: they alone contain any capillary network. The larger blood-vessels, proceeding from the trabeculæ, traverse the lymph spaces of the trabecular system, to reach the follicular masses.

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## CHAPTER II.

**Anomalies and Lesions of the Thoracic Duct. Rupture of the Lacteals and of the Receptaculum Chyli. Chylous Effusions into Serous Cavities. Movement of the Lymph and Chyle, and Forces Concerned in their Locomotion. Pathological Considerations.**

The thoracic duct is subject to many vices of formation. It may commence higher or lower in the abdomen, consist of one or more branches, divide at one or at several points between its origin and terminus, which divisions may again unite into a single trunk, or each branch may empty separately either in the left or right subclavian vein, or it may empty at some unusual point. Instances of very many and very remarkable deviations in structure, form, course, size and termination are to be found in the literature of the subject.\* Bartholinus in 1686, and Walther in 1731, recorded cases of bipartite ducts; Haller saw two instances; and Soemmerring twice found it completely double, in one case both terminating on the left side, one empty-

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\* Otto, *Compendium of Human Anatomy*, translated by South, pp. 355, 356. Soemmerring, *De Morbis Vasorum*, *Absorb. Corp. Hum.*, pp. 22, 24. Cruikshank, *Anat. of the Absorb. Vessels*; Mascagni, *Vasor Lymphat. Corp. Hum.*; Baillie, *Morbid Anatomy*; Breschet, *Système Lymphatique*, p. 255; Haller, *Disputationes ad Morborum*, vol. iii., p. 537, and *Elem. Physiol.*, p. 224.

ing into the jugular and the other into the subclavian vein, in the other case a duct terminated on each side in the subclavian vein. Hewson\* describes a case where each branch possessed a separate entrance into the subclavian veins, and in the Monro anatomical collection is a specimen showing a division of the duct into the large branches, one ascending on each side of the aorta and again uniting into a common trunk near the opening into the vein. Cruikshank (loc. cit. p. 175) refers to a similar case and to instances of double and triple ducts, of transposition to the opposite side, and various other irregularities in the course and connections of the main trunk. Wium, Heuermann, Velse, Pequet, and Rolfink, have seen the duct terminate on the left side by two or three branches, and Otto refers to a wax model of a similar case in the Anatomical Museum at Upsal. Albinus and Wutzer† saw it terminate entirely in the vena azygos, and others have recorded cases in which branches were seen emptying into that vein. Otto has seen it thrust out of its place by exostosis, and, in a single case, by the inferior cava passing behind it and the aorta. Others have recorded instances of its displacement, and occlusion by aneurysmal and glandular tumors. Turner‡ has reported two cases of complete obliteration of the duct, caused by the pressure of aneurism of the aorta: in one case the duct was wanting from the 2d to the 5th dorsal vertebra, and in the other case it was obliterated opposite the 8th dorsal vertebra. In neither case could an injection be forced past the points indicated. Morgagni§ quotes a case from Valsalva and another from Santorinio, in both of which the duct was occluded by an aortic aneurism. In Valsalva's case the aorta "from the heart to the diaphragm" was dilated into an enormous aneurism. Bennett|| and Laennec¶ each report a case. Narrowing or occlusion has also been caused by tuberculous and cancerous growths, by thrombi, by the pressure of tumors††

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\* Syd, Soc. Ed., p, 136.

† Muller's Archiv., 1834, p. 311.

‡ Edinb. Med. Jour., 1859, p. 1003.

§ De Cedibus, et Causis Morborum, Venice, 1761, Liber ii., p. 152; also Cook's Morgagni, vol. i., pp. 418, 420. 1824.

|| Clinical Lectures on Principles and Practice of Med., 1858, p. 570.

¶ Jour. de Med. Chir. Phar. etc., vol xii., 1806, p. 159.

†† Virchow reports a case of complete obliteration of the duct, caused by the pressure of a cancerous growth,



and by cieatrices. Turner refers to a case communicated to him by Mr. Edwards, in which the latter found in the "usual position of the thoracic duct a mere thread of eellular tissue, whilst on the left side of the aorta a duet passed upwards to the great veins on the left side." Sometimes the duet is greatly enlarged at its termination. Todd has observed several instances in which it was so considerable as to present the appearance of an aneurysmal enlargement.

Nuhn\* observed two instances where lymphatics opened into the renal veins, and a third where two large branches communicated with the vena cava inferior. Paget† saw a case of cartilaginous growth in the reté of the testicle and lymphatics of the gland. The lymphatics of the cord were so "dilated and elongated" by a similar growth that they presented a series of tumors, and cysts filled with a fluid which proved, on microscopic examination, to be lymph. From the internal inguinal ring two dilated and tortuous lymphatics, filled with cartilaginous growths, passed upwards and connected with a swelling divided by numerous partitions into cavities containing lymph. The lymphatics connected with this tumor adhered to the vena cava inferior, and from one of them a cartilaginous growth projected into the vein. Petrel‡ has reported a ease in which he traced lymphatics filled with pus, opening into the portal vein, and another in which he found similarly pus-filled vessels communicating with the renal veins and the vena azygos.

*Case 1.* Matthew Baillie§ refers to an instance in which the thoracic duct was nearly as large as the subelavian vein, "but nothing could be detected in the neighboring parts capable of accounting for it. There was no obstruction at the entrance of the duct into the venal system;" and, in a letter to John Hunter,|| communicating an "account of a remarkable transposition of the viscera, he says, "the thoracic duct was seen in the middle between the descending aorta and vena azygos, in some places forming a plexus of several branches, in another dividing itself

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\* Muller's Archiv., 1834, p. 311-

† Medico Chir. Trans., vol. xxxviii., p. 347.

‡ Gazette de Paris, 1845, p. 512, cited by Turner,

§ Morbid Anatomy of some of the Most Important Parts of the Human Body, p. 116, 1833, London Ed.

|| Philosophical Transactions, 1798, p. 354.

into two branches, which afterwards reunited in a common trunk, and at length climbing up to terminate in the angle behind the jugular and subclavian veins on the right side of the body." Cruikshank (*loc. cit.* p. 171) reports a case in which he had seen a trunk of the absorbents of the lungs convoluted (as is imperfectly represented in cut below) at least a thousand times before it entered the duct, and adds, that he had seen similar convolutions in parts of the duct itself.

[Figure 12,]



*Case 2.* [Fig. 12.] "h, Trunk of the absorbent rising out of the lung.

"c, The thoracic duct going up towards the left subclavian vein.

"d, Thoracic duct continued, emerging from under the convolutions."

(If the figure is examined through a magnifying glass, the convolutions will appear very distinct.

Nelaton\* remarks that the thoracic duct, more frequently than any part of the lymphatic system, is the seat of varicose dilatation, but Andral† finds in 300 dissections found it affected in only five cases. A number of such cases have been reported, but comparatively few in which the dilatation was unconnected with vices of texture. The very remarkable case of Amussat,‡ in which the ectasis involved the thoracic duct even to its termination was regarded by Carswell as a congenital malformation. Such was, probably, the nature of the following case of extraordinary enlargement of the thoracic duct reported by Cruikshank.§

*Case 3.* [Fig. 13.] "The large duct will almost exceed belief. It is exactly, however, as found in the human body."

"It is seen in situ, with the more immediately surrounding parts."

"The spine is cleaned by dissection, and dried, in consequence

\* *Eléments de Path. Chi.* T. I., chap. xviii., p. 556, Paris, 1844.

† *Archiv. Gen. de Médecine*, T. vi., p. 502, Paris, 1824.

‡ *Case 59, Amer. Jour. of Obs.*, vol. x.

§ *Loc. Cit.*, Ed. 2, p. 207, London, 1790.

of which the intervertebral substances are shrunk, perhaps to one-twelfth of their original thickness.

"The aorta, vena azygos, and lower portion of the left internal jugular vein, with that portion of the left subclavian vein which forms a right angle with it, are seen as half distended with coarse injection and dried."

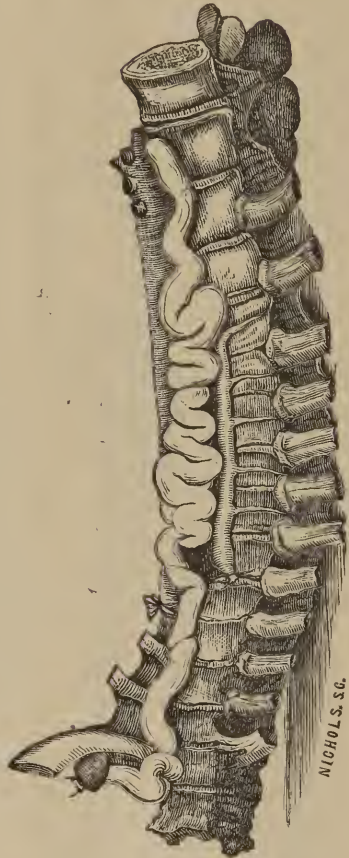
"The thoracic duct is seen under the same circumstances as the last mentioned vessels, as little more than half distended with the injection."

"The man appeared to be about 40 years old. We know nothing of his history. There was no obstruction in the left jugular or subclavian veins, neither were they enlarged; there was no obstruction in the heart or lungs; no uncommon swelling in any of the neighboring parts compressed the duct. The great trunks of the absorbents accompanying the large arteries in the extremities were in proportion large, but the cutaneous absorbents were not larger than usual." \* \*

In a foot-note on page 208, Cruikshank states that he had previously seen the thoracic duct "as large as the carotid artery of an adult, or the barrel of an ordinary writing pen," and also refers to a preparation (p. 175) in the collection in Windmill street, "in which an injection thrown into the umbilical vein of a child passed directly into the thoracic duct."

Vices of texture, in the lymphatic system, are not unlike those found in the veins, and a number of cases have been recorded in which the thoracic duct was found diseased.

[Figure 13.]



*Case 4.* During the winter of 1789, Mr. Astley Cooper,\* failing to inject the thoracic duct of a subject which he was dissecting, opened the duct to discover the cause of the impediment. The first obstruction was occasioned by "two valves placed near to the receptaculum chyli, which were much thicker than natural, and projected into the duct, so that their superior edges (see A, figure 14) were pressed firmly together. An inch from these (B), and higher in the duct, two other valves appeared, diseased in a similar manner, only in a greater degree. These were also so much thickened as to fill the canal, and they formed a barrier beyond which no fluid could pass." At a point oppo-

[Fig. 14.]

Fig. 16.]

Fig. 15.]



site (C) the curvature of the aorta, the duct was obliterated by disease which seemed to have originated in the valves. Beyond this point the duct was healthy, and opened in its usual manner into the vein. Mr. Cooper supposed the disease was of a scrofulous nature, as between the laminae of the valves was discovered a substance "having the same curd-like appearance with that found in scrofulous abscesses." \* \* \*

"The absorbent glands of the neck were enlarged, and many of them imperfectly suppurated, and the person appeared to have died of phthisis pulmonalis, the lungs being loaded with ulcerated tubercles."

*Case 5.* During 1790, Mr. Cooper was requested by Mr.

Waterworth to assist him in making a preparation of the thoracic duct and the large vessels which accompany it. The injection passed about an inch and ceased to flow. Greater pressure being applied, the injection penetrated as far as the "left crus of the

\* Medical Records and Researches, p. 86, London, 1798.



diaphragm and there escaped from a divided absorbent". When the injection was forced into the divided vessel (see D, fig. 15), it passed up on the left side of the aorta, crossed the spine behind that vessel and terminated in the thoracic duct proper", which became filled with the injection above the part diseased. The first obstruction was occasioned by a "small fungus" (E), and the second, at the point of rupture (F) by "another fungus, larger than the former, which completely occluded the vessel. "Wherever absorbents entered the duct, the valves at their termination were thickened and opaque," but there was no obstruction above the fifth dorsal vertebra, so that above that point, "the duct was still capable of performing its natural functions." The appearance of the diseased parts was similar to those in the preceding case. "The mesenteric glands were enlarged and the peritoneum was studded with tubercles."

Mr. Cooper maintained that the obstruction did not cause death because the anastomosing branch (D) communicating with the lacteals conveyed the chyle to the healthy portion of the duct, and thus it reached the blood.

The following case, the third reported by Cooper, is peculiarly instructive, illustrating, as it does, the relation between pathological changes occurring in the duct with disease originating in remote parts of the lymphatic system, and the conservative efforts of nature to avert the immediate danger, to life, of such morbid changes, by the establishment of anastomosing connections with the venous system.

*Case 6.* "Enlarged testicle, abdominal tumor, and enlarged absorbent vessels and glands."

"John Hammett, a laboring man, aged 22, was admitted into St. Thomas' Hospital, January, 1795. \* . \* About five months before he had been attacked with pain in the right testis, which soon after swelled and had continued to enlarge to the present time. Seven weeks previous to admission he had observed a tumor in the abdomen, to the right of the navel. At the time of admission the testis had attained considerable size, but preserved its natural figure, being flattened on its sides, and round on its fore part; it felt pulpy, yet not fluctuating; the spermatic cord was somewhat enlarged. The tumor in the abdomen, small when first observed, was now four inches in diameter and occasioned very considerable pain. General health was good."

"Two weeks after admission he had lost the healthy and florid aspect, complained of great pain in the abdomen, extending in a line from the testis to the tumor, and lost strength very rapidly. His pulse became quick, and feeble; had continued thirst, a great degree of restlessness, his appetite failed and his bowels became irregular, sometimes costive, at others very loose. Suffered from distention in the upper part of the abdomen, after taking a small quantity of food, which continued for several hours."

"The patient continued to grow worse, the pain increased in intensity, extended from the tumor to the testis, along the spermatic cord and down the thigh. Exhausted by vomiting and diarrhœa, he died February 14th, 1795."

*Autopsy.* The testis was a "pulpy mass, composed of broken coagulable lymph, and of a blood-colored serum."

"The absorbents of the spermatic cord were considerably enlarged, their coats thickened, valves diseased, impervious, and containing matter similar to that found in the testis, which adhered firmly to their internal coats."

"The small glands in the loins, which receive the absorbants of the testis and cord, by their enlargement and union, formed a tumor on the lumbar vertebra, weighing nine and a half pounds." This tumor forced the duodenum and pancreas forward and compressed them between it and the abdominal parietes. The tumor exhibited a similar appearance to the testis.

"The thoracic duct was much altered; its coats were thickened and opaque, and it was much rounder than usual, bearing more resemblance to a nerve than to the principal trunk of the absorbent system." "The receptaculum chyli was filled with matter of the same kind as that found in the tumor, in the absorbents of the spermatic cord, and in the body of the testis. \* \* The thoracic duct had undergone a similar change and was impervious (see K, fig. 16). Opposite the curvature of the aorta the duct was lost in a large swelling (L), which differed only in bulk from the abdominal tumor." (Figure 16, J, receptaculum chyli; K, thoracic duct; M, the duct emerging from the tumor; N, aorta.)

Cooper expresses the opinion\* that the disease was cancerous,

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\* Otto (loc. cit. p. 361) says: "In medullary sarcoma of the testicle we very frequently observe a similar sympathetic affection of the lymphatic glands on the spermatic cord, pelvis and spine, or less high up, in which case also the

in the testis, tumor and duct. To ascertain the course of the chyle he injected mercury into an absorbent of the loins, which passed as far as the receptaculum, then "ran through several vessels behind the aorta into a large trunk which passed the whole length of the chest on the left side of the spine," to the first dorsal vertebra and there entered the thoracic duct above the tumor K.

At page 117 (*loc. cit.*) Cooper supplies the following illustration, showing an obstruction of the thoracic duct by disease (L), and the formation of a new duct (N), which communicated with the duct proper at O, thus restoring the connection between the receptaculum and the subclavian vein.

*Case 7.*

- A, Aorta.
- B, Vena azygos.
- C, Thoracic duct.
- F, Right absorbent trunk.
- G, Right subclavian vein.
- H, Left subclavian vein.
- K, Superior cava.
- I I, Jugular veins.
- L, Tumor on duct.
- N, New thoracic duct.
- O, Entrance of new duct into

the duct proper.

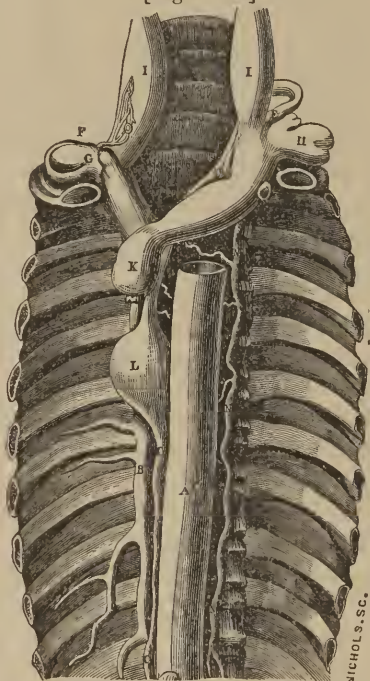
No history accompanies this brief report. The case is analogous to the preceding one in exhibiting the provision of nature to prolong life, so imminently threatened by the occlusion of the duct by the adventitious growth at L.

*Case 8.* Obliteration of the thoracic canal. M. Andral, fils,\* "in 1821, on opening the body of a phthisical patient found the thoracic duct, for several inches above the diaphragm, filled with a notable quantity of lymph.

ductus thoracicus frequently becomes at the same time affected." He refers to a number of illustrative cases, but after an examination of the cases I do not find this opinion corroborated.

\* *Archiv. Gen. de Med.*, T. vi., Sept. 1824, Paris, p. 502.

[Figure 17.]



It suddenly diminished and lost its transparency at a portion corresponding to the bodies of the 3d, 4th and 5th dorsal vertebrae; but from the 3d vertebra to its termination in the vein, the canal regained its former size, its transparency, and seemed to be filled with lymph. A stylet introduced immediately above the diaphragm penetrated its cavity easily to the level of the 5th vertebra, but here encountered a sort of cul-de-sac which was impenetrable. In the whole of its length, where the canal seemed to have shrunk, it was impossible to discover the slightest trace of a cavity, this portion being transformed into a fibrous cord. By careful dissection Andral found a large lymphatic vessel—a second thoracic duct which, arising from the principal duct a little below the point at which it was obliterated, passed obliquely upward and outward behind the azygos vein, and opened into the proper conduit above the point of obliteration, forming at this point a sort of anse similar to that which the thoracic duct forms before entering the vein.”

The same author gives the details of two other cases (*loc. cit.*)—in one (case 9) after death from chronic nephritis, he found the thoracic portion of the duct filled with pus, with marked inflammation of its coats. The right kidney was “transformed into many pouches filled with pns.” but nothing peculiar was found in the glands or vessels of other parts. In the second case (No. 10), a boy of 11, who had died of croup, with pleuropneumonia and gastritis, he found the walls of the duct thickened and more friable than normal; the lumen contained but little transparent serum—its lining membrane was markedly inflamed. The glands along the duct and those about the receptaculum were in their centres tuberculous. He has also reported the case of a woman\* (No. 11), who died of abscess in the broad ligament, and peritonitis, in which he found several vessels communicating with the duct, filled with pus, and in (case 12) another instance† he found the canal distended with a “white, friable, concrete substance, resembling tuberculous matter.” In a sixth case‡ he observed the duct enlarged to the size of a “writing pen” from the pillars of the diaphragm to its outlet, and distended with a purulent fluid. In the latter case (No. 13 of this series) the intima of the duct was red, thickened

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\* *Precis de Anatomie Pathologique.*

† *Ibid.*

‡ *Archiv. General.*



and easily detached. Abscesses in the broad ligament and iliac fossæ were also present.

Gendrin\* saw (case 14) in a woman who had died of peritonitis, the receptaculum chyli distended "with white consistent pus." Its walls were red and friable. The thoracic canal throughout its entire course contained pus, and its internal surface was studded with plastic concretions adherent to its wall.

Velpeaut (case 15) found pus in the duct of a woman who had died of puerperal fever, with abscess in the ovary and broad ligament.

Quincke refers (Ziemssen's Cyclo., vol. vi., p. 522) to cases reported by Cruveilhier and Andral, in which cancerous matter and pus were found in the thoracic canal in cases of uterine sarcoma. Tonelè records (Prac. Treat. on Dis. of the Uterus, Boivin and Duges, p. 330) a case of puerperal metritis, in which the lymphatics of the abdomen were distended and of a milky color; the thoracic duct was enlarged and filled with pus.

*Case 16.* "Joseph Lientard‡ reports the case of a young man, aged 22, suffering from a certain malignant epidemic fever, who complained of cardialgia, difficulty of breathing, pain in the side, with bloody and viscid sputa, nausea and vomiting, epigastric swelling and diarrhœa. These symptoms were followed about the 6th day by convulsions which quickly terminated life.

"On opening the abdomen, he found an obstructed mesentery covered with various livid and gangrenous spots. The thoracic duct and the receptaculum were in a state of gangrene and turgid with a grayish brown fluid. The stomach, intestines and lungs were in a somewhat similar condition."

*Case 17.* "Anne Norris,§ aged 40, healthy, fat, and well made, was admitted, December, 1828, to the Dublin Hospital, laboring under feverish symptoms of a few days' duration, which had commenced with a rigor.

"A painful swelling, mistaken for fecal accumulation, was discovered in the left iliac fossa. On the seventh day a sweat apparently critical supervened," the fever subsided, and she returned to her usual laborious occupation. On the 5th of Jan-

\* *Historia Anatomique des Inflammations.*

† *Archiv. General*, vol. vi., p. 220.

‡ *Historia Anatomica Medica*, Lib. ii., p. 33; 1767. Paris. Edited by Anthony Portal, M.D.

§ *Graves and Stokes, Dublin Hospital Reports*, vol. v., p. 43; 1830.

uary she had a decided rigor, and returned to the hospital on the 7th, complaining of pains in the trunk and extremities, most acute in the lumbar region, and accompanied with heat of the skin. The tumor was painful; had enlarged. Death took place suddenly on the 9th.

*“Autopsy.* Not emaciated. Sigmoid flexure displaced by the tumor, which was caused by an abscess in the psoas muscle, extending from below Poupart’s ligament to the last dorsal vertebra. The abscess contained healthy pus; when emptied, its parietes seemed formed of the envelop of the muscle, much thickened and stronger. The internal sac was quite smooth, and exhibited toward its inferior-posterior portion five or six orifices of the diameter of peas, funnel-shaped, and having their surface continuous with that of the sac. They terminated in organized tubes, which led to a mass of diseased glands that lay on the brim of the pelvis. \* \* The vessels between the glands and the abscess were filled with pus, and the glands were distended with matter, in some still fluid but thicker than pus; in many it was converted into a soft cheesy mass. From these glands ascended a chain of lymphatics communicating with the thoracic duct, and containing solid matter resembling tubercles. The thoracic duct was distended to the size of the middle finger, felt hard and nodulated, and contained similar matter, harder and mixed with a large proportion of a calcareous substance. The uterus was filled with caseous matter; the other abdominal and thoracic viscera healthy.”

*Case 18.* De Inflammation du Canal Thoracique.\* “A man aged 48, large, lank, with health broken by arduous military service. After a chill, with sore throat and fever, he was seized with violent pain deep in the belly, which radiated to the sides, accompanied with malaise, sleeplessness and high fever. These symptoms moderated and were followed by acute pains in the muscles of the left forearm, thighs and calves. Power was completely lost in the left arm. The abdominal pains recurred with augmented intensity, his face denoted great suffering, complexion became icteric, tongue coated, and sordes collected about the teeth. Skin was dry, pulse hard, not above 80, scleroticæ became yellow, belly tense and tympanitic, but painless on pressure. Intelligence remained unimpaired. Circumscribed swellings formed on the posterior surface of the left arm and on

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\* Jules Worms, *Gaz. Hebdomad.*, vol. vi., 1859, p. 279.

the forearm, and the superficial veins became distended, painful, felt like cords; the blood could not be pressed out of them toward the heart. The left subclavian vein, in its axillary extremity, became hard and rolled under the finger like a cord.

*“Autopsy.* Whole body, except left arm, intensely yellow. Veins of the left arm distended, surface ecchymotic, skin thickened, aponeurosis thickened but no pus in its meshes. All the tissues of the arm stained deeply yellow. Blood in the veins viscid, decolorized, looking like bile. The lumen of the cephalic and basilic veins irregularly filled, at some places empty. The left subclavian was doubled in size, and completely obstructed at its junction with the internal jugular, with a yellow, hard, slightly adherent, organized mass, which extended 6 centms. toward the axilla, and sent a prolongation into the jugular. The veins from the junction to the heart were filled with partially clotted blood, and a fibrinous clot occupied the cavities of the right auricle and ventricle, which also extended for some distance into the pulmonary artery. Heart normal; lung congested inferiorly and posteriorly. Solitary intestinal glands deeply ulcerated; spleen enlarged, softened; liver normal; portal vein filled with blood. Thoracic duct obliterated at its outlet by a mass pressing upon its descending portion. The remaining portion was dilated to the size of a crow’s quill and gorged with pus. Its walls were thickened and opaque; the internal surface softened, velvety, ecchymotic and without epithelium. Receptaculum enlarged, filled with pus; its walls were in a condition similar to those of the duct. Mesenteric glands enlarged. Supra-renal capsules disorganized and seeming to be connected with the reservoir of Pecquet by lymphatics, filled with a purulent fluid.”

*Case 19.* (Lieutard Obs. 771). “In the body of a boy 12 years of age, who died of a scrofulous affection, was found, in addition to the usual lesions of the mesentery, pancreas and other abdominal viscera, the receptaculum of extraordinary size and studded with tuberculous tumors.”

In reviewing the cases presenting morbid alterations of the tissues composing the thoracic duct, the first inquiry suggested, relates to the connection which these changes bear to the diseased conditions found in other parts of the lymphatic system. Which was primary? We find these pathological changes, somewhat

analogous in character, associated with tuberculous degeneration of the lungs and mesenteric glands, with gangrene of the lungs and abdominal viscera, with suppuration of a chain of cervical glands, with abscess in the kidneys and lumbar glands, and with cancer of the testis. These morbid conditions, whether malignant or benign, were not only the results of alteration of nutrition, but of degenerative processes which, if they did infect the general system directly, necessarily involved, either immediately or remotely, the entire economy through its nutritive processes, and the invasion of remote parts might eventually ensue either as the inevitable consequence of systemic infection or of the nutritive actions of morbid life. In all the cases the lymphatic system was chiefly involved; in some the extension from one to another part was by direct continuity of vessels, in others it was propagated by conveyance of infective or morbid material through anastomosing and connecting lymph channels, or was derived from infected and degenerated glands in near proximity. In one case (No. 5) in which the duct was occluded by an adventitious growth, it is impossible to determine its primary or secondary character, and the case (No. 9) of nephritic abscess, in which the thoracic portion of the duct was filled with pus, with a markedly inflamed intima, it is only possible to connect these phenomena upon the hypothesis, not wholly improbable, that pus from the abscess found its way through the renal lymphatics into the duct, and there either accumulated or set up an inflammatory process which supplied the occluding accumulation of pus. But it is inexplicable how such a quantity of pus could have been conveyed through the intervening channels, interrupted by one or more tiers of glands, without setting up a similar inflammatory process along its course; and equally inexplicable is it that such a collection of pus should have found lodgment in the precise section of the duct, except upon the additional supposition that there existed previously some cause of obstruction, perhaps diseased valves, which, as in one of Cooper's cases, may have been the preliminary seat of the morbid changes found in the duct. So far, then, it is impossible to accept any exclusive view in regard to the primary or secondary nature of the pathological phenomena found in the diseased ducts. It is obvious that disease may originate in the tissues of the duct, but not probable, indeed impossible, that the product of such disease could be transmitted to parts anatomically



behind the original seat, except by regurgitation of the contents of the duct, or through the blood-current, in the latter event becoming disseminated throughout the system. The similarity of the morbid products found in the duct to the associated degenerative changes recognized in other parts, strongly supports the view that, in such cases, the lesions of the former were secondary, because they were in the line of the onward course of the lymph toward the venous system; and, as in the case of Graves and Stokes, in which the greatly dilated duct was filled with morbid material identical in character with that found in ectatic vessels directly connecting it with the original focus of disease, it must be conceded that lesions of the duct may and do succeed to diseases of remote parts of the lymphatic system.\* The case of cancer of the testicle more fully illustrates this conclusion.

The case of Anne Norris (No. 17) suggests another interesting consideration. In comparative good health, and sufficiently nourished, though suffering moderately from localized pain, two days after venesection to 10 oz. and an enema, which relieved all subjective symptoms, she suddenly expired. The duration of the psoas abscess cannot be determined, though it is probable that it had commenced long anterior to her first admission to the hospital, as it was very large, though the formation of pus had not produced any emaciation, hectic or marked constitutional suffering. That the abscess communicated directly with lymphatic channels cannot be doubted, and the probability is that this communication had been effected gradually, but that suddenly a copious discharge of pus had taken place into these channels, completely filling the lumen of the thoracic duct and producing death. The extraordinary dilatation of the duct, and its knotted and nodulated condition, indicate a gradual process of disease, but the remarkable exemption from the usual subjective phenomena attending such large collections of pus is but another illustration of the fact that accumulations of pus may exist in closed sacs, (Graves,) involving distention of soft tissues, but

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\* "From the narrowness," says Quinke, "of the vascular lumen, only fluids, or very minute bodies suspended in them, can be conveyed along the lymph stream: very rarely are thrombi swept along with the current. Such solid particles seem not to pass beyond the nearest lymphatic gland; yet the inflammation of the lymphatics may be propagated beyond these glands, the irritating matter being conveyed beyond them, either in solution or in the interior of lymph cells."—Ziemssen's *Cyclop.*, vol. vi., p. 515.

unaccompanied with any hectic or constitutional symptoms and without any evidence of any preceding inflammation, and especially is this true when the sac of pus is confined to lymphatic structures. the sacs found in my own case (No 1 Amer. Jour. Obsts.), filled with debris and disintegrated material, illustrate the innocuousness of such collections, and, occasionally, little collections of pus form in the glands, and this fluid is, according to Gendrin, very different from that found in the cellular tissue, "in its clearness, transparency, and colorlessness."

These cases exhibit the same marked tendency of the diseases of the lymphatic apparatus to morbid processes of a destructive nature, enfeebling the constitution and promoting rapid waste, which is so distinctly expressed in a number of the congenital cases. Occasionally, however, inflammation of an adhesive character is set up. In Andral's case (No. 8), a portion of the thoracic duct "was transformed into a sort of fibrous cord," and this condition was observed in a patient who had died of phthisis. The ductus thoracicus has also been several times observed obstructed or adherent from coagulated and exuded lymph.\* In one of Cooper's cases the valves were ulcerated and adherent.

As a rule, diseases involving the texture of the thoracic duct are secondary, and the result of infection by morbid products transmitted through the lymph stream. Even in the case reported by Worms (18), the idiopathic nature of the inflammatory changes which took place in the walls of the duct is rendered doubtful by the condition of several afferent vessels, which appeared to have been connected with the disorganized suprarenal capsules. The reporter maintains that the duct was the seat of the primary affection, and attaches special significance to the deep-seated pain in the abdomen, which radiating towards the sides, quickly followed a chill with sore throat, and preceded the graver phenomena which ensued and increased in intensity until death took place, as denoting the locality of the disease which was so manifest in the tissues of the duct. The character and locality of the pains are, however, insufficient to establish such a conclusion; indeed, it is not improbable that the degenerative process taking place in the suprarenal capsules may have been the *fons et origo* of the pain, and the more serious and ominous symptoms which followed may

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\* Otto refers to a number of such cases, which I have not had the opportunity of examining, some of the references being inaccessible and others inaccurate.

have been due to the invasion of the tissues of the duct and its extension in continuity. The morbid condition of the left arm and forearm were certainly sequent to the occlusion of the subclavian vein, but there was no necessary connection between the affections of the left upper extremity and thoracic duct, unless the occluding thrombus was in some way the result of the admixture of the purulent contents of the duct with the blood. The descending portion of the duct was obliterated by the pressure of a mass located in and about the angle formed by the junction of the left subclavian and internal jugular veins, and the organized mass which so completely occupied the lumen of the subclavian may have originated from the same cause. The current of lymph and chyle through the duct was certainly arrested before death, but how long before cannot be determined, and hence the causative relation which the infecting and purulent contents of the duct bore to the formation of the thrombus at the locality of its outlet cannot be positively ascertained. It is not improbable, however, that the occluding mass, as suggested by Worms, had its beginning in changes produced in the blood by admixture with the pus, and that the localized affection of the left upper extremity, and general phenomena manifestly due to blood-poisoning, were secondary, at least, to the structural changes in the tissues of the duct. The thrombus was yellow, and all the soft tissues were "intensely yellow." To this circumstance Worms directs especial attention, though not the first to observe the presence of icterus in connection with diseases in which pus was found in the lymphatics. He insists that the yellow discoloration was due entirely to blood changes caused by the presence of the puriform matter from the thoracic duct. The observation is suggestive. Whatever connection, if any, there may exist between diseases of the thoracic duct and icterus, when it is not obviously dependent upon hepatic derangements, can only be determined by careful examination of the duct in such cases. Lebert attributes (Ziemssen's *Cyclo.*, vol. i. p. 291) the icterus of the typhoid variety of relapsing fever to a peculiar element of septic infection, and all who recognize the lymphatic tissues as blood-producing organs must accept the conclusion that morbid conditions of these structures must exert deleterious influences upon the composition of the blood, and, consequently, upon the nutrition of the body. It is quite certain that some poisons gain access to the system through the lym-

phatic apparatus, and it is not improbable that the special poisons of the infectious fevers may enter through the same channels. The prevalent belief is that the infection of typhoid fever finds its entrance through the lymphatic follicles of the intestines. The jaundice was most probably attributable to solution of the red blood corpuscles and transformation of the hæmatine into yellow pigment, and it is not impossible that the admixture of pus with the blood was an important factor in producing this condition of the blood.

In this connection the case of mitral and tricuspid insufficiency, with granular liver, ascites, anasarca and thrombosis, reported by Oppolzer,\* deserves consideration. Both the inferior and superior venæ cavæ were occupied at their outlets with pale yellow, rather soft coagula. From the superior the clot extended with a jagged end into the auricle, and continued into the right subclavian, as well as into the internal jugular of the same side as far as the foramen lacerum. Left innominate and terminus of left subclavian were obliterated. The thoracic duct was plugged at its termination by a pale red, fibrous coagulum; its walls were thickened, and the lumen from the receptaculum to the occluding thrombus was much enlarged. The occluding thrombi, both in the veins and duct, were probably blood coagula, the difference in color, one being "pale yellow" and the other "pale red," being due to the difference in time of formation, and not to the admixture of the blood with morbid contents from the thoracic duct; nevertheless thrombi formed in inflamed lymph vessels may be white, red, pale or yellowish, but are less firm than blood clots, and under the microscope will exhibit lymph corpuscles more or less thickly scattered through the mass. In this case the thrombus in the duct was not only pale red, but "fibrous." If it was a blood thrombus, regurgitation of blood into the thoracic duct occurred in consequence of the interruption to its entrance into the right heart, and not as in some cases of rupture of the duct, from absence or diminution of pressure in the lymph trunk. The walls of the duct, as well as the coats of the veins, were thickened, and the thrombi were adherent to their inner surfaces, but no mention is made of pus formation in either system of vessels. Thickening of the coats and enlargement of the canal may result from obstruction to the current. In Virchow's case (see case 58 *Amer. Jour. Obsts.*), the duct was occluded

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\* Allgemeine Wiener Medicinisch. Zeitung, 1861, p. 149.

by a thrombus projecting from the jugular vein, and nearly all the internal organs were enlarged by the dilatation of the lymph vessels.

Other vices of contents have been observed. Besides blood, pus, bile, ichor and other extraneous substances,\* calcareous material has been found in quantities sufficient to completely fill the duct.

*Case 20.* Lieutard (loc. cit. Obs. 771), "on opening the body of a scrofulous subject who died of consumption, found the mesenteric glands enlarged to the size of a nutmeg and *turgid* with a chalky material. The lymphatics were enlarged, especially the thoracic duct, was more than three times its normal size and full of the same material."

*Case 21.* Ossification of the thoracic duct.† "James Jones, aged 22, was admitted into the Gloucester Infirmary, June 5th, 1779, for rheumatism. The right hip was enlarged, but the thigh was but little altered. Soon after he was seized with pain in the knee, and the thigh increased in bulk and became œdematous, and he was confined to his bed. The enlargement of the thigh advanced very fast, difficult and painful micturition ensued and increased, and, finally, the urine could not be drawn off, but 'dribbled away involuntarily.' A tumor was discovered on the left side, filled with fluid and feeling like a distended bladder. His fever increased, strength failed very fast, he gradually drooped into a state of insensibility, and died October 10th."

"*Dissection.* The integuments of the abdomen felt harsh and dry; the veins were enlarged, could be distinctly traced over the surface; on the left side there remained an evident fullness, which pushed the parietes forward. The thigh continued œdematous. The intestines were inflated, bladder distended with urine, slightly adherent to the peritoneum; and this, together with the colon, filled the iliac fossa on the left, while the right and more than half the pelvis was occupied by a confused mass composed of scirrhus, cartilage, bone and stone. Arising from this mass, extending above the kidneys and covering the bodies of the vertebræ, was found a bony tumor. The cartilages of the ribs were as white as writing paper, but retained their natural firmness and texture. The lungs were distended,

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† In a single case worms have been found in the absorbent vessels of the neck: Otto, loc. cit. p. 362.

\* Cheston, Phil. Trans., vol. lxx, p. 323: Lond., 1780.



and studded in many places with bony concretions. The heart was very flaccid, empty, small, but sound in other respects; the valves were normal, the aorta healthy, though entirely surrounded by this singular substance from the coeliac artery to its bifurcation. The thoracic duct was firm like a piece of pack-thread, and was entirely plugged up with ossific matter; from immediately above the receptaculum chyli, nothing could be forced through it; its coats did not appear diseased. In some places the adventitious product was not strongly attached to its internal surface, at other places it could not be separated, owing to the thinness of the coats and their partial ossification. The receptaculum contained a membranous laminated substance, between which and its walls air could be forced, and possibly a small quantity of fluid, but the duct was totally impervious, rendered so by the ossification of the material, presumably of the same nature as that found in the receptaculum."

[Figure 18.]



a, Receptaculum chyli laid open to show substance within.

b, Opening into thoracic duct to show the manner it was blocked up.

c, Lymphatic gland containing a similar substance to that found in receptaculum.

d, Coats of duct separated from the bony matter.

e, Vena azygos.

"The vena azygos was perfectly sound, but the vena cava was half filled with a firm, inelastic substance, which originated from its internal surface near the entrance of the emulgent veins, attached to it here and there by small points till about the projection of the sacrum, where the cavity was almost entirely filled.

"The spleen, pancreas and liver, were perfectly healthy, gall bladder small and empty; the kidneys were enlarged, livid and inflamed; right ureter distended with urine;

the coats of the bladder were thickened, and the organ was extended upwards, oblong and contracted, its neck was compressed by the tumor."

"The tumor which occupied the right iliac region extended

irregularly in all directions, and had by pressure produced absorption of the principal part of os innominatum."

Dr. Cheston concludes the history of this case with the statement that the appearance of the patient was similar to those who had "lingered under and been destroyed by slow inflammations of the viscera."

The affections of the bladder, ureter and the kidneys, were probably secondary, and found their cause in the mechanical impediment to micturition, produced by the pressure of the mass found in the right iliac region, and represented to have consisted of "scirrhus, cartilage, bone and stone;" and whether or not this "confused mass" originated in disease of the lymphatic apparatus of that region, which seems very probable, it is manifest that absorption of bony material took place and was conveyed through the lymph channels to the receptaculum and thoracic duct, and thence into the lungs, forming the concretions which studded the latter organs. Todd refers to a case reported by Andral somewhat analogous to this: "In a woman, æt. 33, who had died of acute pleuritis supervening upon a chronic pulmonary affection, the bodies of six vertebræ, the last dorsal and five lumbar, were found destroyed, and calcareous concretions were found in the cervical, thoracic, bronchial, abdominal, pelvic, axillary, and inguinal glands." And in another, a boy æt. 16,\* in whom an abscess was found in one of the iliac fossæ, with erosion and destruction of the os ilii, calcareous concretions were found in the bronchial, pelvic and mesenteric glands, and in his lungs. Quincke (loc. cit. p. 520) refers to the cases of Wrisberg† and Mascagni,‡ of calcification of the wall of the duct, but these reports I have not had the opportunity of examining.

These calcareous deposits most frequently occur in old people, and consist generally of phosphate of lime. The cases cited suggest its derivation from the earthy matter of the bones. Soemmering§ has observed a tartar-like substance in obstructed glands, and absorbents in cases of rickets, and Freis|| gives an example, in which he found calcareous concretions in the lymphatic vessels about the vertebræ and in various other parts of the body. Some of the older authors maintained that rickets

\* Cyclo. Anat. and Physiol., vol. iii. p. 234.

† De syst. vas. abs. morbus. excit. et san. comment. soc. reg. Gotting., 1789. Bd. iv.

‡ Gesch. und Beschreibung, d. Saugadern, 1789.

§ Loc. cit. p. 45.

|| Soemmering, p. 96. De emollitione ossium.

was the result of increased action of the absorbents, due to a peculiar irritability, existing as a diathetic quality of certain constitutions, which specially directed their action to the absorption of osseous material.

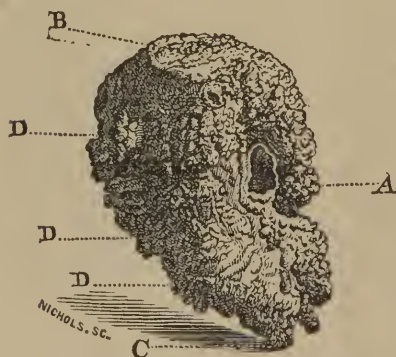
In several of the preceding cases calcareous material was observed in the receptaculum, but always in connection with similar depositions in other parts of the lymphatic apparatus. In the following case, reported by Joan Georgii Scherb (17th August, 1729), the deposit was only found in the receptaculum.

*Case 22. De calculo receptaculi chyli; hydrops causa.\** "A man 39 years old, suffering from dropsy, had exhausted the entire armamentum of the pharmacopea without relief. Paracentesis abdominis was resorted to, but 16 hours after the last tapping the man died."

*P. M. Examination.* "The omentum was found almost entirely decayed and the other viscera in a gangrenous condition." A certain preternatural body (*corpus quoddam præternaturale*), surrounded by a peculiar membrane, was observed in the lumbar region. In order that a good view of it might be obtained, the mesentery was removed. An incision being made, and the membrane, which surrounded the tumor, being cut, a large quantity of lymph poured out and a calculus, whose shape is given in the following wood cut, was extracted.

"The place where the calculus was found, and where the presence of the chyle was noticed, was satisfactorily proven to be the receptaculum chyli."

[Figure 19.]



"A, Large foramen in calculus.

"B, Several openings permitting the passage of a bristle.

"C, Centre of calculus.

"D, Various prominences obstructing the lymphatic vessels."

"In order that a fuller explanation might be had, the thorax was opened, and not the smallest trace of a thoracic

\*Haller, *Dissertatio Abmorbtorum*, vol. iii., p. 537.

duct could be found. It was apparent, however, on examining the stone, that a foramen or cavity, indicated by the letter A, permitted the escape of the thinner portions of the chyle through a fixed passage, and did not impede entirely the flow of the chyle, by means of which the life of the man was prolonged."

This case is not entirely unique; in several of the preceding cases small depositions of calcareous and other extraneous substances were found in the reservoir of Pecquet. Scherb ascribed the dropsy to the presence of the calculus, which interrupted the flow of chyle, asserting, at the same time, that no communication with the venous system could be discovered. the history of this case and details of the post mortem are too imperfect to determine the causal connection of the calculus with the ascites; there are, however, cases which establish the fact that chyle and lymph may be effused into the thoracic and abdominal cavities, and into the latter through rupture of the lacteals, receptaculum or thoracic duct.

*Case 23.* (From an essay on dropsy and its different species, by Donald Monro, p. 22, 3d ed., London, 1765.)

"In the body of a man who died after a large quantity of chylous liquor had been let out of his thorax, Bassius\* discovered, about the third or fourth vertebra, an orifice from which the chylous matter flowed as from a fountain. When the lower part of the thoracic duct, where it rises out of the receptaculum chyli, was blowed into, the air unexpectedly came out at the orifice above mentioned. This white liquor coagulated with salt of tartar, but not with spirit of vitriol."

*Case 24.*† (ibid, p. 22). A girl made too great an effort to raise a burthen, became hydropic soon after. Being frequently tapped, there always issued from the puncture chylous matter, not unlike milk, in color, taste and consistency, which being set on a fire, rarified like milk.

*Case 25.* Percival‡ reports the following case of chylous ascites, which occurred in the practice of Dr Huxham, and was communicated to him by Sir William Watson.

"A girl, about eight years old, was tapped for ascites. She was anasarous, and even her face was very much bloated and

\* Observationum Decade Secunda, Observatio Septima.

† Memoir de l'Acad. des Sciences, 1790. See such another case, ibid 1710.

‡ Essays Medical, Philosophical and Experimental, vol. i., p. 171: Lond. 1788.



very pale. Four quarts of a milky-colored liquor, which would not coagulate by heat was drawn off. After standing a day or two it was covered with a kind of thin cream, and in a few days more it smelled and tasted sour. At a subsequent tapping a similar fluid, somewhat more dilute, was evacuated, the swelling of the body subsided, and she recovered her appetite and strength. Before she was attacked she was very lively and active, had a voracious appetite which she indulged." Percival suggests that she probably ruptured some lacteal by some unusual exercise, after a full meal.

*Case 26.* (Monro, p. 23). "In Dr. R. Morton's *Phthsiologia*,\* there is an account of a hydrops ascites lactea in a boy 2 years of age, which, after his death, was found to have been occasioned by a number of large indurated tumors, situated behind the trachea arteria, which compressed the thoracic duct near the subclavian vein, as much as if a ligature had been made upon it, and had been the cause of a rupture of some of the lacteals."

*Case 27.* "Abdominal effusion, resulting from mesenteric tumors.† G. K., aged 20, a wire weaver, who had enjoyed good health until ten months previous to his admission to the Surrey Dispensary, December 31st, 1840. At the time of admission he was suffering from functional disorder of the stomach; appetite was bad; had occasional pyrosis, vomiting and pain in right side; suffered with flatulence and bitter eructations; tongue was pale and clean, with lateral indentations from the pressure of the teeth; skin was soft and clear; pulse frequent, feeble and compressible; cheeks not wanting in color; expression distressed; not deficient in flesh; complained of debility, palpitation of the heart, and excitement from slight moral and physical causes. He was addicted to venereal pleasures. \* \* \*

"No tumor could be discovered, but a little indistinct fluctuation was supposed to exist; his bowels were confined; passed but little water. The fluctuation and distension of the abdomen increased very rapidly, and he emaciated with extraordinary rapidity. Diarrhœa supervened and he sank, exhausted, on February 17th.

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\* Lib. i., Cap. 10, Et And. R. Vieussens, *Novum Vasorum corporis Humani septima*; Amstelad, 1705, in *Monitione ad Lectorem*.

† Hughes, *Guy's Hosp. Reports*, vol. vi., p. 297; 1841.

"*Sectio Cadaveris*—twenty-four hours after death. Slight abrasion of the skin over sacrum, and some frothy mucus about the mouth. \* \* The lungs appeared healthy; the heart was thin, weak, pale and flabby. \* \* Not a particle of fat was to be seen either in the omentum or integuments. The peritoneal cavity contained seven or eight quarts of a thick and perfectly milky fluid like almond emulsion. The peritoneum was vascular over a portion of the ileum, and was universally sprinkled with minute white specks, a portion of which were easily removed, and consisted of capillary shreds, deposited from the milky fluid, but some were adherent and seemed produced by the membrane. \* \* They resembled more the ova of pediculi capitis than tubercles. In the centre of the abdomen, resting on the spine, was a rounded nodulated tumor, as large as a two-penny loaf, which consisted of several agglomerated mesenteric glands, some of which were as large as a small orange, and, when divided, presented a soft, pinkish, pultaceous mass, from which, upon very slight pressure, exuded a white cream-like fluid, which appeared to constitute a portion of the deposit: others were of a dull white color, drier and more granular—the whole exhibiting \* \* the general characters of cerebriiform cancer. Other glands of the mesentery were enlarged to the size of marbles and pigeons' eggs. Some inguinal glands were also enlarged, but contained no heterologous deposit. Several convolutions of the intestines were adherent to the tumor, but all appeared healthy, except two white, firm, and semi-cartilaginous spots found in the colon, opposite to which the mucous membrane was entirely wanting, and their cut surfaces presented the same physical characters as the early stages of schirrous pylorus. One tubercular-looking body, about the size of a pea, was discovered in the mesentery, close to a fold of the ileum. The liver, spleen and kidneys, were healthy, \* \* Numerous lacteals—large, tortuous, varicose and distended, some with a milky and others with a clear fluid—were observed in all parts of the mesentery." Six ounces of the fluid were transmitted to Dr. G. Owen Rees for examination, who in a letter says:

"I have examined the effused fluid, and find that it contains chyle in considerable quantity. Owing to the chemical character of serous effusions generally, it is quite impossible to determine what quantity of chyle is in admixture with the serum.

Some idea may, however, be formed of its large proportion, when we recollect the peculiar milky appearance \* \* \* When the effusion was agitated with ether, it separated into three distinct parts—the upper being a solution of fatty matter in ether, the lower a clear serum, and the intermediate layer a floating mass of chylous matter.”

*Case 28.* “A particular dropsy.”\* On the 2d of July, 1699, Poncey, jun., drew from the abdomen of a girl, who had been attacked with dropsy 15 months previously, “13 quarts of a white thickish liquor resembling milk, not offensive to the nose, but smelling like milk, between sweet and sour, a little insipid and saltish to the taste.” Upon standing for some hours, cream rose upon the top of the fluid a finger’s breadth in thickness, which remained unaltered after standing five days. Subsequently, “a very thick, greasy substance, like butter, but white, appeared upon it.” From the date of the first operation to March 4th, 1700, the date of the death of the patient, paracentesis was performed 22 times, the aggregate amount of chylous fluid drawn off reaching the extraordinary quantity of 289 French pints.

*Autopsy*, a few hours after death, in the presence of Du Vernage, Leaulté, and Du Chéne.

“The body was lean, abdominal integuments about one-third normal thickness.

“The epiploon was so much dissolved that there were only the vestigia of it remaining, at the place of its adhesion to the stomach and pancreas. Upon the surface of the intestines and in their anfractuositities were found a quantity of white creamy filaments, sufficiently compact to bear pulling, and tenacious enough to have a slender adhesion to the parts. These lacteous concretions were most abundant at the bottom of the abdomen, toward the centre of the mesentery, in the hypogastrium and toward the groins.”

The peritoneal cavity contained about two quarts of a white milky fluid. “The stomach and intestinal canal were so tumefied with wind, and the preternatural bigness of the mesentery raised them so much above the other viscera, that none were perceptible—even the liver, which was deeply lodged under the diaphragma, and so much flattened and extended in bulk that a

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\* Saviard, *Observations in Surgery*—Trans. by Surgion—p. 247. Lond., 1740.

portion of its small lobe was firmly adherent to the spleen, stomach and pancreas, and by its gibbous part to the diaphragma, that it could not be separated without tearing, and was of a blackish color." The gall bladder was withered and empty.

"Obstructed glands were perceived in the texture of the covering membrane of the liver," the largest were of the "bigness of peas." The mesenteric glands were enlarged, some as large as the thumb.

"The progress of the iliac vessels to the right and left were covered with glandular heaps, as large as pullets' eggs, others as large as pigeons' eggs. Upon opening these glands, a very white and thick matter was discharged resembling boiled cream." \* \* \* \*

"From these we proceeded to the examination of the intestinal canal, and began at the pylorus which was fixed to the liver, spleen, pancreas, mesentery and epiploon, and even to some circumlocutions of the large and small intestines. We traced it for 10 or 15 inches without finding anything extraordinary, but observed at the beginning of the jejunum, a sort of membranous bag covered with creamy filaments, which was full of a white milky liquor. \* \* \* At the place where the jejunum is fastened to the mesentery, a round fistulous hole existed, through which a probe penetrated an inch into the glandular part, which was very hard and much tumefied." By dilating the fistulous tract the probe was pushed to the diaphragm without injuring any other part. To the right and left of the tract sinuses were found, which seemed "to have been formed in the body of the mesentery-which had become so much enlarged by the obstruction of its glands, that it seemed to have degenerated into schirre, and the matter contained in them resembled that contained in the peritoneum."

"In the thorax, at the point of the entrance of the ductus thoracicus two very large glands were found, containing a 'curdled matter;' and following the course of the duct other glands were observed, "strung together like beans and full of the same curdled matter."

Poncey concludes that the "complicated dropsy \* \* was owing to obstructions both in the vessels and glands serving for filtration to the chyloferous duct, and to the glands and canals



appointed for the distribution of the lymph over the whole body."

This remarkable case, so minutely and faithfully reported, presents so many post mortem appearances so closely analogous to those found in the preceding case, reported by Dr. Marshall Hughes in 1841, that the apparent vague statements and indefinite description must be attributed to the imperfect knowledge of writers of that date, rather than to the inaccuracy and fancy of the author.

Bassius, Soemmering, Gjorgjevic and others refer to the case (29) of Guiffart, reported by Bartholinus.\* Gjorgjevic intimates that it was a case of traumatic injury of the thoracic portion of the thoracic duct, in consequence of which the chyle poured into the thoracic cavity in quantity sufficient to produce death by suffocation. Hensen, Gjorgjevic and others refer to the case of Hoffmann,† the latter classing it with the cases of Monro, Guiffart and Bonet, as an instance of wound of the duct. Monro, who wrote in 1765,‡ quotes the cases of Bassius,

\* The "opera" of Bartholinus to which these authors refer, is not to be found in any of the libraries of this city.

† Hoffmani Opera Omnia, Supplement ij., Pars ij., p. 461, 1704.

‡ "The first mention of the lymphatic vessels is believed to be found in the works of Hippocrates, in the work on the Glands (edit. Littré v. viii, p. 558). It is doubtful if the author had in view, however, the lymphatics."

"Erasistratus and Herophilus described the chyliferæ, but their discovery, combatted and refuted by Galen, fell into oblivion, and it was not until the xvth century that Nicholas Massa and Fallopius re-found the visceral lymphatics, and that Eustachius described the thoracic canal under the name of the vena alba thoracis. Useless conjectures, the works of these anatomists were of the same sort as those of their predecessors."

"In 1622, Gaspard Aselli discovered anew the chyliferæ of the dog; in 1628, Gassendi demonstrated the presence of the lymphatics in the intestines of man; in 1649, Pecquet re-found the thoracic canal and described the termination. Two years after, Olaus Rudbeck (Sappey, tome i., p. 658) saw the lymphatics, properly speaking, generalized their existence, demonstrated their presence elsewhere than in the small intestine and liver, and discovered the lymphatic trunks of the extremities. At the same period, Thomas Bartholin and Joliff confirmed the discoveries of Rudbeck, which were completed later by the works of Ruysch (1665) F. Meckel, Hewson, Mascagni and Hunter (1780)."

"In spite of these works so multiplied, the origin of the lymphatics remained unknown; glanced at by Hunter and by Cruikshank, in 1780, they were not defi-

Morton and a third case (23, 24 and 26), but does not refer to the wounding of the duct in either of these cases; on the contrary, in case 26, he ascribes the rupture of the lacteals to the compression of the thoracic duct near the subclavian vein by a number of indurated tumors; in the case of Bassius (No. 23), no cause is assigned for the opening in the duct through "which the chylous matter flowed as if from a fountain;" and in case 24, it is simply stated that the girl "became hydropic" after "an effort to raise a burthen." Rudolphi, who wrote in 1835,\* asserts "that a wound of the thoracic duct, without co-existing injury to a portion of the body necessary to life," had not happened, and insists that the "only case of wound of the thoracic duct in man as yet shown is that given by Bonet." Gjorgjevic surmises that Rudolphi was unacquainted with the cases of Monro, Hoffmann and Guiffart. I am unable to determine the nature of the lesion in the case referred to Guiffart, and accept the opinion of Gjorgjevic, but I must dissent from the interpretation of the case of Bonet by Rudolphi, and from the intimation of Gjorgjevic, that Hoffmann's case was one of injury to the thoracic duct. The reports of the cases, which follow, will exclude them from the category of lymph fistulæ; in fact neither is entitled to a place

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nately demonstrated until 1830. At that period, and nearly simultaneously, M. Cruvelhier, Panizza and Fohmann, established the existence of the plexus of origin; it is more particularly to Fohmann that is due the merit of having first proved the existence of a tegumentary plexus."

"The pathological history is even more modern than their anatomical history. Down to Hewson (1783) their pathology was consigned to the second rank, and the cases which describe them are to be found scattered either in treatises on anatomy or in collections of observations."

"At the close of the 18th century, after the labors of Cruikshank and of Mascagni, the study of diseases of the white vessels was conducted with avidity; but it was sought rather to find in them the secret of life, to make them the point of departure and the seat of all affections (see Soemmering de Morbis Vas. Abs., 1795), than to study traumatic lesions."

"However this ardor soon slackened, and the study of the lymphatics was very nearly forsaken, when there appeared the researches of MM. Andral, Allard, Cruvelhier, Dezeimeris, Velpeau (*Maladies du Systeme Lymphatique*, Archives gen de Medecine, 1835-36) then the excellent article of Ollivier (*Diet-en* 30 vol. t. xviii)."—BINET, *L'Echo Medical*, Tom. iij., 1859, p. 60.

\* Ueber die Todtlichkeit der Wunden Brustganges, in der Casperschen Wochenschrift fur gesamte Heilkunde, 1835, Nos. 41, 42 and 43.

here, and I introduce them simply to correct a frequently repeated error.\*

\* *Case† 30.* “*Disquisitio medica circa affectum pectoris varissimum perpetui succi nutritii ex thorace stillicidii.* A very learned man, a mathematician, and likewise a theologian, of a sanguineo-melancholic temperament, slender figure, nervous, and of sedentary habits; indulging in the use of acidulated drinks; 43 years of age; frequently attacked with rheumatism since he was eleven years old; suffered with a dry, hacking cough, which began in the autumn and lasted all the spring, unaccompanied with expectoration. His calling exposed him to the influences of a dry, cold climate, which at length produced some fever and a sharp pain in his side. Making use of certain remedies, amongst which were pectoral pills and opiates, he spat up with the cough a great quantity of matter without any difficulty. The food taken was frequently vomited; he became emaciated, his strength left him, his respiration was labored and difficult, so that he could hardly move about without much pain. In the following winter, whilst he was trying with difficulty to perform his duties, a copious purple eruption, which began on his chest but afterwards extended over his body, appeared, which when exposed to the cold air passed away. After a few days there suddenly came on in the evening an attack of asthma, which was so suffocating that he could hardly breathe, accompanied with great pain in the breast and abdomen, and obstinate constipation. These pains continued for 12 days and nights without remission, which reduced his strength. The constipation gave rise to tympanites, although with other remedies there were used as many as 20 enemata, until at length, from the use of the juice of the borsdorsian apple, the flatus was expelled, after which the abdomen collapsed, and the sick man lay resembling a skeleton. During this space of time (12 days) the patient suffered the most excruciating pains in his body, horrible twitchings, and burning sensations as if balls of fire were moving through his bowels. It is remarkable that his intellect remained unimpaired during these pains, though he had an occa-

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\* To Dr. Murphy I am indebted for the translation of these and other reports. To him and Drs. Lee, Kleinschmidt and Drinkard, I am under many obligations for their valuable assistance in aiding me to collect the material for this essay. It has always been cheerfully rendered, and frequently at great sacrifice of time.

† Hoffmann, loc. cit., 1704.

sional attack of syncope. His whole body after awhile was one rack of pain, and covered all over with boils, so that for three entire weeks he was not able to stir hand or foot. When by the help of others he attempted to rise from bed, when his feet touched the floor he experienced the most acute and indescribable pain in the right shoulder and side, and his head was turned from left to right, as if by an iron band. It is also worthy of notice that the pulsation of the heart which is observed in the left side of the chest was changed to the right, and could be seen near the right nipple, hence the sick man could not raise himself erect without suffering acute pain. On the cessation of all pulsation in the left side of the chest, other phenomena were observed, to-wit, from the sternum to the left dorsal spine the chest was distended and gradually protruded like a large hunch-back, so that the heart and lung of the left side were crowded into a small space. There were present also great distress in the præcordium, difficult respiration, and if he wished to touch the ground with his left foot, with each step he was compelled to bend his shoulder. His sleep was disturbed during the entire night, owing to the constant cough; his appetite was almost gone, and if he should take food there was the greatest difficulty in swallowing it, owing to the great contraction in the orifice of the ventricle (larynx). With these symptoms all hope of returning health vanished, and with the advice of His Serene Highness and the entire Consistory, the sick man abandoned himself to his fate after the disease had progressed for nearly four years. He was not able to lie unless on his left side, and could not turn towards the right for fear of suffocation, and the lump protruded more and more from the left side of his chest, its large size not only hindering respiration but also the taking of food or drink. Various remedies were employed, but in vain, so that the œdematous swelling which previously had occupied his feet extended to his abdomen and head, and his eyes became so prominent that death seemed imminent. It happened at the time that a celebrated surgeon came along who, upon examination, easily discovered a large quantity of fluid to be collected in the cavity of the chest, and he learnedly pronounced it to be collected between the external coverings as if in a sac. He determined therefore to evacuate the fluid by tapping (paracentesis). He perforated by means of a double-edged knife the cutis from be-



hind between the ribs, immediately above the diaphragm; and when he had entered sufficiently, a sound was heard as if a bladder distended with water had been burst, and on withdrawing the knife, immediately there flowed a certain material of the consistency and color of white milk and devoid of all odor. The quantity of the material evacuated weighed three pounds. The tent being introduced the wound was bound up. After the operation the patient experienced a double relief: 1st, the painful and annoying pulsation of the heart in the right side immediately ceased; 2d, that he was able to walk about without any of his former inconvenience. On the following day, the tent being removed and a larger instrument used for widening the wound, 4 pounds of fluid escaped. In the evening of the same day, a leaden canula was introduced, through which there passed four pounds of fluid; and in the same manner in about four days an immense quantity of matter, beyond twelve measures, were drawn off from the cavity of the chest. It is curious that after the evacuation of this material, as often as the body was shaken there was heard a noise in the left cavity as if a little rope was dangling in water, which sound was not heard until a few weeks after the opening, and then not any more. During this time there were exhibited the necessary remedies for the medication of the wound, etc, and the sick man so far recuperated that there were hopes entertained of his speedy return to health. However, there appeared around the aperture certain tumors and some inflammation, especially when decoctions used for dressing wounds were passed through the canula and the material withdrawn, which operations were not without pain; these symptoms subsided spontaneously however. After the space of three years, the opening of the aperture was surrounded by a hard cartilaginous substance, so that a small canula could be with difficulty introduced into it, and the flow of the material was much impeded; though after the material air was wont to escape with such force as to extinguish a candle held near to it. For a number of years subsequently the material continued to flow daily without impediment, so that in the space of twenty-four hours there would pass the fourth part of a wine measure, or twelve ounces, or half a pound. The quality of the material was like the rest, and the color generally the same unless altered by the difference of food, when it would become sometimes yellow,

sometimes ashy-colored, at other times brown. The consistency was sometimes thicker, then again thinner. If perchance a drop or two of blood should flow from an unguarded wound of the vessels, it would not be intimately mixed with the material itself, but remain separated as regards its color."

"This praiseworthy man remained in the state I have described, not having gained flesh, strength, or much power in walking, omitting the less prominent symptoms. From external cold and moist atmosphere he was not sufficiently protected, and immediately there followed inflammation around the aperture and the tumor, likewise weakness in the throat, continuous eructations, and vomiting the things he had swallowed. In swallowing, if too much air were admitted, he would suddenly be seized with a spell of coughing with constriction of the fauces. The diet used was light and simple, more fluids being admitted than solids, juices especially, and milky substances being given; he preferred acids more than anything else. Besides the facts mentioned in the history of the disease, there are other phenomena worthy of mention, viz.: after the opening in the left side of the chest near the dorsal region had been made, as often as remedies for cleansing the wound and diluting the liquid in the chest, such as Spanish wine, or water from china root, or a decoction of sarsaparilla, were injected into the cavity, there would follow in one or two hours a distinct paroxysmal fever. It is also a notable fact, if the dressing of the wound or the evacuation of the material were delayed for a single day, it would seek out means of exit, and during the night, whilst the sick man would be lying on his left side, he would be seized with coughing accompanied with expectoration in large quantities. Another phenomenon was likewise observed: if he had to undertake a journey, and should remove the canula for one day, which was placed constantly in the aperture, he would experience no inconvenience from riding. If during the diseases to which this reverend gentleman was subject, he abstained from food and drink, this material which was evacuated would not be lessened in quantity, or very much changed from what it was when there was less wasting of strength."

This was undoubtedly a case of empyema, and, as such, is especially interesting. The graphic delineation of the symptoms, the accuracy of the diagnosis of the presence of fluid in

the pleural cavity, the courage of the surgeon in incising the chest wall, though it was not the first operation of thoracentesis, the use of the tent, the employment of the rude canula to afford constant drainage, and through which to wash out and medicate the pyogenic surfaces, and the prompt recognition of the communication between the pus-producing cavity and the lungs, leave no room to doubt the ability, sound judgment, and accurate observation of the medical men who lived when the science of medicine was shrouded in mystery and prejudice, and show that we of the present day, notwithstanding our enlarged opportunities and proverbial boasting, are in many things but borrowers and copyists.

*Case\* 31.* "The illustrious Baron de Heinden being injured by a missile in the battle of Fionensis about the middle of the dorsal vertebræ, the ball passing out under the left scapula, did not suffer very much in the beginning, he merely endured the usual symptoms of wounds. After 14 days he observed on the linen an abundant white fluid (humor), and continuing at intervals; but was utterly ignorant from what source it came, or what was its nature. Neither the physician or surgeon whose services he employed gave any opinion concerning it. It stuck to him during the winter at Ottensonia (his abode at that time); but in the month of April, being transferred to these regions, he at once called to his aid my services. I found the distinguished patient suffering much, emaciated, and slightly feverish in the evening of each day. I at once made inquiry about the lung being injured, although he said that up to that time no symptoms from that region had manifested themselves. The opening of the wound above had healed; below, it exuded the accustomed matter. I began to hope for the best results, but after the lapse of two days I noticed that the above named white fluid, now, however, changing to yellow, had flowed in such abundance as to stain not only the five-fold linen dressing, the under garments, and the bed clothes, but even to saturate thoroughly the bandages. Astonished at the strange matter, I immediately began to think, as it was clearly different from corruption and ichor, that the periodical fluid, the chyle namely, designed for the entire nutrition would flow in this unusual way,

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\* Boneti Sepulchretum Anatomica Prat. Lib. IV. Sect. iii., p. 360. 1700.

since the patient, although having a good appetite and using the choicest and most nourishing food, grew more emaciated in body from day to day."

The baron preferred "death to surgical interference," and Bonet placed his patient upon a strict diet, "and administered internally and applied externally the choicest balsams," which together with "the blessing of God," produced such a marked improvement that in 14 days "the fever and flow" had abated, and the "habit of body became sensibly more florid, to the great joy of the patient, who considering himself free from all danger," \* \* \* "betook himself to the more ardent drink, an old custom of his." The flow returned and continued "to the end of his life, which his restlessness of mind and body greatly accelerated." In consequence of some excitement he was "seized with epileptic fits and afterwards with left hemiplegia, which in a few days carried him off, his shrivelled body being destitute of strength."

*Autopsy.* "The body was opened in the presence of Holotius Poliateus. The lower extremities presented nothing worthy of notice; the lungs in that part where the wound had been received had begun slightly to decay, but the examination showed that that was slight at first and fraught with no danger."

Bartholinus, to whom the details of this case were communicated, says: "If\* I may be permitted to express an opinion, the thoracic duct was thus injured, that there escaped an abundant supply of chylous fluid followed by consumption or wasting."

There is certainly nothing in the history, progress and termination of this case, which will establish the conclusion that the thoracic duct was wounded by the missile. The character of the discharge, the accompanying fever and progressive emaciation, continuing through a period of probably six months, indicate exhaustion and emaciation from a protracted and suppurating wound. The hemiplegia and epilepsy more probably found their cause in some injury of the spinal column than in some incidental mental excitement, superinduced by the loss of chyle.

Traumatic injuries of the absorbent vessels seem to have been a subject peculiarly attractive to many of the older authors. Ruysch, as early as 1665, drew attention to wounds of the

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\* Sepulchretum Anatomica, p. 361, Tom. iii. 1744.



lymphatic vessels, and refers to a certain surgeon, "who had unfortunately cut a lymphatic vessel in incising a venereal bubo not completely developed, from which flowed daily a great quantity of lymph." Solingen, in 1693, reported two cases of "lymph fistulæ situated at the head of the soleus muscle, one consequent upon a wound, the other produced by contortion of the limb." Muys, in 1695, saw a young man who had been wounded in the left external malleolus, and from the wound "there flowed every day a vast quantity of water." Nuck, in 1733, wrote of wounds of the lymphatic vessels; "very often," he says, "in venesection performed on the arm, and, especially, when performed on the foot, the absorbent vessels are injured; by carelessness in regard to these vessels the lancet has proved fatal." Van Swieten, in 1764, recorded the observation that frequently most abundant discharges of lymph followed venesection, and Haller, a few years later (1773), stated that he had known a "flux of lymph of such long continuance, and so difficult to arrest, that he could explain its existence only upon the supposition that a large vessel" had been severed in blood-letting. Mascagni and Assalini, in 1787, cited cases of lymphorrhagia following venesection; the latter mentions the case "of a boy 11 years old who lost 5 pints of lymph in three days from a slight wound located upon the internal part of the thigh." Soemmerring (1795) and Mouro also recorded observations of discharges of lymph following slight wounds; and Schreger (1799) mentions an instance of lymph fistula following blood-letting in the foot. Soemmerring remarks (*loc. cit.* p. 53) that the healing of wounds on the instep, near the ankles and knees, on the back of the hands, near the bend of the elbows and near all joints, is impeded by the continual dripping of lymph, and offers the explanation that as the "absorbents about the joints are protected only by very thin skin and very little fat," the swelling and inflammation which ensue prevent contraction and compression of the incised vessels. In 1817, Nasse recorded several instances of lymph fistulæ caused by traumatic lesions of lymph vessels; in some of the cases he analyzed the fluid discharged and proved it to be lymph.\* Since then, lymph fistulæ from traumatism seem to have attracted but little attention, though quite a large

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\* M. Nelaton has three times met with dilatation of lymph vessels at the fold of the elbow, on a level with the cicatrices of bleeding.

number of cases of lymphorrhœa and lymphorrhagia, occurring in consequence of diseased conditions of some portion of the lymphatic system, have been carefully recorded. Such cases will be considered under the head of lymph fistulæ.

During the period when traumatic lesions were attracting so much attention, which was subsequent to the discovery of the chyliferæ of the dog by Aselli, of the lymphatics in the intestines of man by Gassendi, of the receptaculum and thoracic duct by Pecquet, and of the lymphatic trunks of the extremities by Rudbeck, and about the time when the works of Ruysch, Meckel, Hewson, Mascagni, Cruikshank and Hunter, appeared, there were reported very many cases of chronic ulcers with fistulous openings, from which a fluid was discharged which the observers believed to be lymph. Even as late as 1859, Binet maintained that neglected lesions of lymph vessels would give rise "to ulcers of the most rebellious character," and suggests that ulcers of the lower extremities very frequently owe their origin "to alterations of the lymphatic vessels." Such ulcers may be recognized, says Binet, "by the abundance of the matter excreted, compared to the extent of the ulcer; by the increase of the excreted fluid when gentle pressure is made from the extremity towards the lesion; by the exceptional difficulty in cicatrization, and by the nature of the excretion." During the same period—previous, however, to the publication of the investigations of Mascagni, Cruikshank, Hunter and Hewson—there were also a number of cases of "milky discharges" recorded. These were evidently cases of copious and, perhaps, somewhat modified purulent secretions. The instance of "milky saliva" reported by Antonio Nuck,\* and the case of "milky discharge from the cutaneous

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\* "Præcæus observed saliva evidently milky. For a woman, he says, nursing a child, again became pregnant, and therefore weaned the child. The right breast from neglect became like a large tumor, and on a certain night subsequently, while suffering much pain, she had an abundant discharge of milk from the mouth, with a corresponding decrease of the swelling in her breast. She swallowed the milk as it came into her mouth (without any inconvenience), which continued for four months."

"But it may be asked, how came the decrease in the breast? In my judgment in no other way than this, that the masses of the blood were laden with chyle, the particles of which could not permeate the lactiferous tubules of the mammae on account of their collapsed condition, but formed a tumor in those nearest the mammary gland, especially since their arteries were filled and were not capable of removing any more. Indeed, the chylous and milky particles were abundantly

surface of the abdomen" reported by Rommel,\* are the most authentic of these curious cases. Among these dubious cases may also be enumerated the case of Schnurig,† of a milky discharge from a wound; the case of fistulous communication with cold abscesses or deep-seated suppurating glands;‡ of milky discharge from the pleural and peritoneal surfaces by Chomel;§ from the uterus|| by Dolæus; from the tunica vaginalis;¶ and from the mucous membrane of the nose by Richter.††

Assalini relates (Binet) having seen, during many months, discharged from the neighborhood of the umbilicus, in two women recently delivered, a fluid which he believed to be of a lymphatic nature. Both women succumbed to puerperal accidents. When Assalini wrote (1787) the lymphatics were being studied, and it is probable that he accepted conclusions without verification, as did Soemmerring after him, who, perhaps, mistook various collections of pus for metastases of milk. Puzos,‡‡ whose conception of the pathology of puerperal diseases seems to have been limited to the supposed formation of depots of milk in various parts and tissues, reports several cases in which collections of milk were found in the abdominal cavity. In one instance he found a "gallon of coagulated milk," the patient having died of fever five days after delivery of a dead fœtus.

The view held by Puzos, and by others previous to his time,

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distributed through the blood mass, and permeated the glandular structures, especially the salivary, which offered the least resistance. In the meantime the blood, on account of its freer and quieter motion, propelled the chylous particles remaining in the breast towards the veins and thus to the heart; hence it followed the breast was emptied." *Sialographia, etc., Ductuum Aquosorum Anat. Lugduni Batavorum, 1695, p. 49.*

\* A woman who was nursing twins began to complain, a few days after the death of one of them, of a sense of dull pain and tension beneath the ribs of the right side of the abdomen and over the umbilicus. This feeling was succeeded by stretching, the stretching by itching, and the itching by an exudation of fluid from the skin, the color, taste, and consistence of which were identical with milk, and which yielded a true butter on agitation." *Ephemerides Germaniæ, decur ij., ann. viij.*

† *Parthenologia, Dresden or Leipsig, 1729.*

‡ *Med. Essays and Obser., by a Society in Edinburgh, vol. 5, part 1, p. 328. 1747.*

§ *Memoire Acad. des Sciences, 1728.*

|| *Epidem. Germ., decur ij., ann. vj., obs. 76.*

¶ *Madras Quarterly Jour. Med. Sci., vol 1, p. 180.*

†† *Med. and Surg. Obser., Transl. Ed., 1744.*

‡‡ *Memoirs sur le lait ripander, on depots laiteux, new edition, Paris, 1801, p. 141.*

that milk was formed from the food of pregnant women and passed commingled with the blood throughout the system, being determined, during gestation, to the uterus to nourish the fœtus, and to the breast, after delivery, to nourish the infant, lead very naturally to the conclusion that a superabundant supply or deficient consumption would eventuate in the formation of depots of milk in other localities. This erroneous theory, improperly applied to the explanation of the nature of certain not infrequent complications of the puerperium, is at least suggestive of the important relation, now being studied with so much assiduity, which the lymphatic system may bear to certain puerperal diseases. In the further prosecution of pathological research, the doctrine of metastasis, so conveniently set forth by the older authors, to elucidate many occult morbid phenomena, and now partially explained by the recent doctrine of embolism and thrombosis, may yet find its complete vindication.

Previous to 1800, and even later, many of the surgeons who wrote concerning the nature and cure of such lymphatic tumors\* as are now known to be suppurating glands, held that the tumors arose from rupture of the lymphatic vessels, and that the fluid (humor) which they contained was true lymph† extravasated and collected in the cellular tissue. Bienl, in describing the causes which predisposed to these affections, enumerated the rheumatic, arthritic, scrofulous and rachitic diatheses, nevertheless he maintains that external violence, a traumatic lesion, be it a slight compression or contusion, was always necessary. These views were combatted by Marcus Fehlnert‡ in an elaborate dissertation,

\* The following is an example. "Adolphus O, 17 years old, always enjoyed good health except an attack of measles and scarlet fever, from which he suffered no evil consequences, and an attack of whooping cough in his thirteenth year, which destroyed his appetite and caused much emaciation. After this a tumor not larger than a bean appeared between the scapulæ, which increased in its periphery and soon gave signs of fluctuation. At the expiration of eleven months it had attained the size of a pullet's egg, but was unaccompanied with pain or change in the color of the integument. At this time another began to form below and around the first lumbar vertebra, which soon attained the size of a hen's egg. These tumors were incised in the most dependent parts, and a large quantity of lymph mixed with a fibrous material was evacuated."—Trasch. Inaug. Dis., 1821.

† Soemmerring attributed dropsy and œdema, R. Morton, phthisis, and Brambilla, fungus growths in the joints, to rupture of the lymphatics. Bassius held that in cases of chylous hydrothorax the thoracic duct was ruptured, and Kerkringius believed that all internal dropsies and all œdemas resulted from disturbance of the lymphatic circulation.

‡ Inaug. Dis. Tumore Lymphatico, 1820.



in which he very clearly pointed out the fallacies upon which the theory of lymph extravasation were based, and proved conclusively by experiments and by analysis of the contents of the tumors, that the fluid was pus.

In view of the foregoing considerations, it is not surprising that Hoffmann and Bonet should have been imbued with the prevailing teachings of the time, and been misled into the belief that the discharges in their cases were the "nutritious juice," evacuated from the thorax. And notwithstanding the vague and ambiguous reports by Assalini and Puzos, coupled as they are with their wilful and somewhat vainly conceived explanations of the phenomena they did not understand, and of the somewhat doubtful, though less equivocal, cases of Monro and Percival (Nos. 24 and 25), the post mortem examinations in the cases of Bassius, Morton, Poncy and Scherb, establish the existence of lesions of the chyle ducts which would allow the escape of the fluid contents. To these, the cases of later date add a special and attractive interest.

*Case 32. Chylous Dropsy\** "M. had been indisposed for a considerable length of time; his disease was supposed to be connected with some morbid affection of the liver, and treated accordingly with mercurials and other remedies; but nevertheless, at length ascites became manifest. A few hours after his death, I was sent for to evacuate the hydropic effusion previously to the body being placed in the coffin. I drew off about 16 quarts of fluid resembling milk, perfectly inodorous and insipid, and some of which I kept for many weeks without any appearance of decomposition."

*Case 33. "Abdominal tumor with milky discharge.†* Mrs. Reed, aged about 40, naturally of good constitution, enjoyed comfortable health until 1817, when, while pregnant with twins, an umbilical rupture took place which disappeared with delivery. Soon after a tumor, apparently solid, was discovered in the abdomen, which occasioned pains similar to labor pains and was

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\* F. W. Weaver, Med., Surg. and Pharm. Repos., Aug. 10, 1814, vol. ij., pp. 377, 378.

† Truman Abell, Med. and Surg. Jour., Boston, vol. vij., p. 13, 1833.

followed by anasarca, accompanied with difficult breathing and great debility. Several punctures were made in the legs, and a free discharge took place for several days. After the disappearance of the dropsy, another tumor was discovered in the right side extending from the spine of the ilium to the diaphragm, which caused much pain and great distension. This tumor appeared solid and was non-fluctuating. After 1825, the abdomen appeared to be distended from ascites, presenting a uniform surface, and the distinctness of the tumors became less apparent. As the disease advanced, the umbilical tumor protruded and eventually formed a bag of irregular shape, the apex, which was the umbilicus, being elevated five inches from the surface and in the middle seven or eight inches in circumference, with two lateral processes like nipples, about one inch each in length."

"On the night of July 17th, 1832, the tumor burst at the umbilicus, and during the night and early part of the succeeding day 25 lbs. of fluid were discharged, followed by great exhaustion and fainting. "The fluid was milk and without any disagreeable odor, more than if taken warm from a cow." The two original tumors remained, which the reporter supposed were ovarian.

*Case 34.*—"Lymph concretion in right pleural cavity.\* The patient died ten months after an amputation at the hip-joint for malignant tumor of the thigh. The heart, kidneys, and left lung were free from disease, and also the bronchial, mesenteric and lumbar glands. The right side of the chest contained an

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NOTE.—Fatal case of vomiting of a chyle-like fluid. On the 12th of October, Dr. Lawrence Sprague was hurriedly called to see a man, who had previously enjoyed good health, and while performing his duty as a mariner had been suddenly seized "with a severe pain in his stomach and bowels," and "across the lumbar region," accompanied with "puking" of a "great quantity of chyle, having the appearance of milk in a frothy state." He was pulseless, surface was "deathly cold," countenance was pale, "and his whole aspect bore marks of immediate dissolution." The vomiting was unaccompanied with nausea, without effort, and continuously flowed from his mouth, seeming to flow "through a channel without any perceptible effort to propel it, and no obstruction to its escape, but completely closing the mouth," so that at times suffocation was threatened. The flow continued for more than a half hour during life, and increased immediately after death. The quantity discharged was variously estimated—by some as much as one gallon.—*New England Journal of Medicine and Surgery*, vol 12, p. 4, 1823.

\* Curling, London Lancet, vol. 1, 1857, p. 352.

immense cyst, filled with a substance resembling medullary carcinoma,\* but which proved on careful examination to 'consist of softened and degenerating lymph.' There was no evidence of malignant disease—no secondary deposits in any of the organs."

*Case 35.*†—"A case of milky ascites. A government ship painter, æt. 59, with lymphatic constitution, and affected for a long time with chronic bronchitis and ascites, in 1793 had two ribs fractured. From 1812 to 1816, had every morning an œdema of the lower extremities, disappearing slightly on moving about and not interfering with ordinary occupations. In 1824 was attacked with pleurisy which became chronic. The last affection from which he suffered commenced with bronchitis. During the course of this affection, a gouty affection of the feet appeared, but at the end of four days it migrated to the chest. The bronchitis became chronic. An expectoration of purulent phlegm, containing tuberculous concretions, increased from day to day. Respiration became difficult, and attacks of asthma frequently occurred. Ascites complicated the bronchitis, and was caused by the interruption of the circulation in the lungs. In consequence of the imminent danger of suffocation, the patient was tapped. The fluid rapidly accumulated in the abdominal cavity, and the operation was repeated a second and a third time, the patient dying three days after the last paracentesis."

"The quantity of liquid evacuated at each operation was about 12 litres. Its color was similar to that of milk. Left at rest in a large vase for several days it deposited large flakes of a white and slightly yellowish color"

*Characters of the fluid:* opaque, frothy upon agitation, and presenting the aspect and consistency of milk rich in cream; an odor of rotten eggs; sp. gr. 1.018, and reddened litmus paper. It was composed of albumen, 7.38; fatty matter, 1.75; mucus, .25; chloride of sodium, .65; lactate of soda, .20; and traces of sulphur, water and loss, 89.77."

"The clot was dirty white, slightly elastic, presented a fibrinous appearance, and was composed of water, coagulated albu-

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\* E. Wagnér maintains that cancer may be developed from the walls of the lymphatics, and reports a case in which cancer was developed in this manner in the lymphatics of the lung and pleura.—Arch. de Heilk., iv. S., p. 538.

† F. S. VanCamp, Annals of the Medical Society of Anvers, 1842, p. 86.

men, fatty matter, chloride of sodium, lactate of soda and sulphur."

*Case 36.\**—"Milky Ascites. A girl, æt. 8, had been sick one year; vomited frequently, and was emaciated. The symptoms were analogous to those of tubercular peritonitis. The autopsy showed numerous tubercles in the lungs and a very large ascites."

"The proportion of albumen contained in the fluids was determined by three different experiments as follows:

By coagulation,	- - - - -	5.33
By the proportion of azote,	- - - - -	5.07
By the difference of residue of evaporation,	-	5.58

In consequence of these analyses, M. Lorain established the composition of the fluid as follows:

Water,	- - - - -	92.25
Fatty matter,	{ acid, - - - 0.61 } { non-saponifiable, 1.23 }	- - 1.84
Albumen, or analogous azotized matters,	- -	5.33
Salts, chlorides, sulphates, salts of lime,	- -	0.34
Loss,	- . - - -	0.24
		<hr/> 100.00

*Case 37.†* "A woman, aged 62, with subcutaneous œdema, and very considerable milky effusion into the sacs of both pleuræ and of the peritoneum, with dilatation of the heart, thickening and shortening of the mitral valve, thickening of the pyloric half of the coats of the stomach, the intestinal villi turgid with a whitish fluid. The sub-pleural lymphatics of the lungs were distended, the lacteals and the thoracic duct in the following condition: They were for the most part, especially from the intestine to the nearest range of glands, mostly nodularly dilated, and stuffed full of a whitish, soapy, unctuous mass, which broke down uniformly in water, to which it communicated a slight opalescent cloudiness. This mass consisted of an agglomeration of fatty granules, chrystals of margarin, oil globules, and a few cells, some of which contained nuclei of

\* M. Lorain, *Comptes Rendus*, etc., de la Société de Biologie, vol. 5, 2d series. Paris, 1859. pp. 162, 166.

† Rokitsansky, *Path. Anat.* Bd. ij., S. 388; also Ziemssen's *Cyclo.* vol. vi., p. 531.



considerable size. In isolated spots, particularly at the varicose nodosities, the mass was of a yellowish color, and adhered to the walls of the vessels. At these parts the vessel was covered with a network, and was here and there quite occluded. The meshes of the network contained agglomerations of fatty granules. The glands were not much enlarged, and were here and there studded with white specks. The receptaculum chyli and vessels entering it were dilated, their coats thickened; the former was lined internally with a grayish red reticulated stratum, from which a nodular excrescence here and there protruded, or a filamentous bridge extended. The thoracic duct was occluded by a similar soapy material, partly filled with indurated material and quite blocked up."

*Case 38.* Hoppe-Seyler\* refers to a case of "rupture of chylous vessels, caused by the pressure of a tumor, in which through a puncture, several litres of a chylous fluid was obtained from the abdominal cavity, in which he found diastatic ferment in a very slight quantity; no pepsin, no albumen digesting, or fat decomposing ferment."

*Case 39.*†—"Obstructed thoracic duct; rupture of receptaculum chyli; peritonitis. Charles S., æt. 19, a shopman, had been suffering for about a week from constipation and loss of appetite, and had taken a good deal of purgative medicine. Two days before admission, he was attacked by severe abdominal pain and tenderness, with vomiting; these symptoms were much relieved by opium, and enemata, which caused the bowels to act. On admission there were some abdominal pain and tenderness; the patient lay on his back with his legs drawn up, and during the night he was a little delirious. The next morning he was seized with vomiting, and brought up much yellowish matter of a somewhat purulent appearance, and then fell into a state of collapse and died in a few hours." "On post mortem examination, the peritoneal cavity was found to contain some turbid yellow fluid, and the surfaces were smeared with a little soft yellowish lymph. The peritoneum in front of the spine was found to be bulged forward; this appearance was produced by the

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\* Archiv. f. die, Gesamte Physiologie des Menschen und der Thiere, vol. vij., p. 497.

† W. Cayley, Transactions of the Pathological Society of London, vol. xvij., 1866, p. 163.

effusion of a large quantity of milk-looking fluid behind it. The effusion extended as far as the brim of the pelvis. The thoracic duct throughout its course was found immensely dilated; at its termination it was about the calibre of the little finger; it was distended by a milky fluid resembling that extravasated behind the peritoneum. The receptaculum chyli was much dilated, and on its anterior surface was a small perforation about two inches in length. The lymphatic glands in the dorsal and lumbar regions were much enlarged and soft, and appeared infiltrated with a milky fluid; this condition on the right side extended into the iliac region. At the junction of the thoracic duct with the subclavian vein, the former suddenly became narrowed, and its coats thickened, and just at its mouth a fibrinous granular vegetation was attached to the lining membrane of the vein, which almost completely obstructed the opening of the duct. The narrowed part of the duct was completely blocked by a firm, yellow, cylindrical coagulum; on removing this, a very fine probe could just be passed from the duct into the vein. The body was moderately well nourished, and all the other organs were normal. On microscopical examination, the milky contents of the dilated duct were found to consist of lymph corpuscles, and a large number of cells which could not be distinguished from pus."

*Case\* 40.*—"Specimen of milky or chylous fluid removed from the abdomen. W. P., a hawker, aged 24 years, a dark, unhealthy-looking man, first came under my observation in November, 1864. He had then chronic capsular rheumatism, from which he recovered. In August, 1865, he had a relapse, after exposure to wet and cold, and was again restored. In July, 1867, he caught cold, which was followed by swelling in the lower limbs and scrotum. When admitted to the hospital his face was congested; urine scanty, loaded, not albuminous; abdomen tense with flatus, but containing some fluid, and its small superficial veins generally enlarged. \* \*

\* On the 14th of July the abdomen was tapped, and 14 pints of an opaque milky fluid were drawn off, sp. gr. 1010. The fluid curdled slightly, effervesced a little on the addition of acetic acid, and displayed under the microscope a few compound granular cells, but seemed chiefly composed of small amorphous par-

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\* Ormerod, communicated by Dr. Wilks. Transactions of the Pathological Soc. of London, vol. xix., 1868, p. 199.

ticles, scarcely separating on standing. On the 18th the wound reopened, and the fluid which drained for several days coagulated into a gelatinous mass. No tumor could be discovered in the abdomen. On August 3d, 18½ pints were evacuated. It contained a few compound granular cells, and some large cells less granular. The amorphous molecules, which moved with a slight flickering, were the most numerous objects. Acetic acid caused a thick granular curd to rise to the surface; boiled with liq. potassæ the fluid turned dark brown. Nitric acid and heat gave a very slight precipitate. On August 16th, 17 pints of fluid were drawn off, which was followed by an attack of pleurisy on the right side, during which the fluid did not accumulate so rapidly. On September 1st, 12½ pints were drawn off, and on the 14th, 14 pints were evacuated, and a few days subsequently he escaped from the hospital." Subsequently he reappeared as a patient of the Brighton Dispensary, was again tapped, and died on the 4th of November.

"Body much emaciated, abdomen containing 16 pints of the same milky fluid. Peritoneum white and opaque. Close to the spine, behind the intestines, extending from the liver to the promontory of the sacrum, and including the upper part of the right kidney, was a hard, white, nodulated tumor. \* \* \* Spleen large and soft; liver small, thin, thickly studded with masses of a dull white color, from one to three lines in diameter. The left subclavian vein and its affluent vessels were plugged with a light-colored ragged clot, evidently of long standing. It was softened in the centre, and at one point was firmly adherent to the walls of the subclavian vein. The opening of the thoracic duct appeared healthy between this clot and the opening of the jugular vein. Behind the innominate, pressing on it, but not involving its coats, was a white mass \* \* \* like the white masses found in the abdomen. The mediastinal glands, heart and right lung, were healthy; the left lung was compressed by recent pleural effusions of an opaque color, quite unlike the peritoneal fluid. The masses from the abdomen and chest \* \* \* consisted of an imperfectly-fibrous structure, the fibres not being simply such, but rather misshaped cells and amorphous granules, strung in rows, with many fat cells. \* \* \* The deposit in the liver was more woolly, contained no fat, none of the chrysalloid fatty deposits, nor any well-developed nucleated cells."

Dr. Wilks examined the fluid and found it to have a specific gravity of 1010, containing little or no sugar, and precipitating no casein by acids. He found under the microscope innumerable granules, but no distinct oil-globules; it coagulated by heat, and on standing, spontaneously. He concluded that the fluid was not milk, but of a chylous nature, holding fibrin and albumen.

A specimen of the fluid was examined by Dr. W. Marcet, assisted by Mr. M. O. Salter, who furnished the following tabulated result of the analysis.

Composition of the peritoneal fluid in 1000 parts:

Reaction,	-	-	-	-	-	-	Alkaline.
Specific gravity,	-	-	-	-	-	-	1012. 5
Water,	-	-	.	.	.	.	-947.73
							<hr/>
Solid matter,	-	-	-	-	-	-	52.27
Albumen,	-	-	-	-	-	-	17.26
Substance resembling caseine,	-	-	-	-	-	-	2.39
Fatty matters,	-	-	-	-	-	-	19.93
Chloride of sodium,	-	-	-	-	-	-	6.51
Bile and sugar, phosphoric acid, lime, and other undetermined substances,	-	-	-	-	-	-	6 18
							<hr/>
							1000.00

Dr. M. concluded that the fluid was "principally chyle," and suggests that the large amount of fat leads to the presumption that it was actually nothing but chyle; "but that the presence of the bile acids, not found in pure chyle, appear to show that the emulsion consists of chyle mixed with more or less of the common serous peritoneal effusion, which, according to Lehmann (*Phys. Chem.*, vol. ij., p. 323), contains frequently, if not usually, the bile acids." If, however, the investigations of Fleische are correct, the presence of the bile acids may be explained by the direct communication of the hepatic lymphatics with the thoracic duct.

*Case\* 41.*—"Oily Ascites. M. P., æt. 27, a maiden, menstruated at 20, and at 23 her menses ceased, never to return. She was a patient at La Charité as an incurable, because she was

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\* Bergeret, *Jour. de l'Anatomie*, T. ix., 1873, p. 586.



unable to take care of herself. At the age of 13 she had typhoid fever, subsequent to which her lymphatic system was attacked. At the time of her admission she had "*écrouelleux*" discharges from the groins and armpits, and suppuration in the back. Under appropriate treatment the discharges ceased rapidly and the sores healed, but at the same time her belly became enlarged. On August 1st, 1873, her abdomen was very large, and increased so rapidly that respiration became seriously disturbed; cough ensued, and became very troublesome both day and night. At both apices of the lungs there were softened tubercles. On September 10th, her belly was punctured and a milk-like fluid, with a light bluish tinge, was evacuated; sp. gr. 1.007, reaction neutral. Under the microscope were seen fat drops, varying in size; no other figured elements. On October 11th, a second operation was performed, a similar fluid being evacuated, sp. gr. 1.740. Under the microscope it exhibited a serosity holding in solution granulations 'refringentes,' without any large drops of oil."

"The fluid contained :

Fatty matter per litre, - - 16.70 grammes.

Albumen in considerable quantity.

Considerable chlorides.

Sulphates in small quantity.

Phosphates in doubtful quantity."

*Case\* 42.*—"Milky Ascites. A child six weeks old had a very severe attack of whooping cough, which lasted for two months. Two months after its cessation the parents noticed an enlargement of the abdomen, which continued to increase until the distention produced such dyspnœa that the attending physician gave up the case as hopeless. At the age of nine months (Oct. 1873), Wilhelms performed the operation of paracentesis abdominis, evacuating 16 "schoppen" of a milk-like fluid. After the evacuation of the fluid the abdominal organs were carefully examined, but nothing abnormal could be discovered, except a tumor about the size of a hen's egg, situated in the umbilical region and firmly attached to the spinal column. The operation of paracentesis was repeated ten times in the succeeding seven

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\* Correspondenz-blatt der ärztlichen Vereine der Rhein-provinz, 1873-1875 No. 14, p. 23.

months. Rindfliesch pronounced the fluid pure lymph, which entered the abdominal cavity from a ruptured thoracic duct. Wilhelms supposed the tumor to be an hypertrophied lymph gland, fistulous, and in connection with the thoracic duct, through which the lymph was poured into the abdominal cavity."

*Case 43.*—Effusion of chyle into the peritoneal cavity.\* "R. W., æt. 30, single, always delicate; secretion of urine frequently greatly diminished, ceased entirely for several days in her 12th year; subsequently a densely œdematous swelling gradually developed in the right leg and forearm to the degree now existing. During the winter of 1873 and '74, she suffered with frequent attacks of pulmonary and gastric catarrh, and towards the spring the abdomen became distended, the urine diminished and ceased entirely for three days. In May, 10 litres of a milk-like fluid were evacuated. Reaccumulation very rapid. In June following, both lower extremities became œdematous. The integument was tense, thickened, surface irregular. Right arm and abdominal integument œdematous. Considerable ascites. Thoracic viscera displaced upwards. Secretion of urine scanty, amounting to only a few cub. centim. per day, rarely increasing to 100. No albumen. Diet mostly milk. There were six tapplings altogether. Œdema of legs steadily increased. A clear, sometimes yellowish fluid, continuously dribbled in considerable quantity from small integumentary fissures. Death from asthenia took place Sept. 5th."

"The first specimen of ascitic fluid was milk white, and formed upon standing a layer of cream; no smell; alkaline; under the microscope it behaved like chyle, showing innumerable molecular drops and single lymph corpuscles, partly containing fatty granules. With the addition of a few drops of a solution of caustic soda and shaken up with ether, it became perfectly clear and yellowish, like an ordinary exudation. Upon evaporation of the ether, a firm fat was left. When freed from fat the fluid was rich in albumen, and when deprived of albumen it reduced oxide of copper in an alkaline solution, but not in a low temperature. The fluid from the different tapplings varied in appearance, sometimes less opaque, but was always the same under the microscope, and coagulated. In May it yielded 1.68 p. c. of fat, and

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\* Quincke, Deutsch. Archiv. fur Klinisch. Medicin., 1875, Bd. xvi., p. 128. Leipzig.

in June 187, varying in specific gravity from 1.016 to 1.013 in June."

Section Cadaveris, by Prof. Langhaus. "Great decomposition; abdomen much distended; greenish discoloration upon the abdominal organs; bloody infiltration of organs of chest; cadaveric emphysema at several places, beneath parietal peritoneum of anterior abdominal walls, in mucosa of stomach and large intestines, liver, spleen, kidneys and muscles of heart. Right pleural cavity contains one litre of a reddish, slightly turbid fluid, with milk white flakes, partly lying upon the costal pleura in separate spots, and which owed their color to the presence of granular fat. No sign of pleuritic inflammation. In left pleural cavity  $\frac{1}{4}$  litre of blood-red fluid without flakes. Both lungs hyperæmic and slightly œdematous. Blood-red fluid in pericardium. Heart flaccid, enlarged, decomposed, in left side well coagulated, in right side fluid dark red blood. Muscular tissue in fatty degeneration." "The abdominal cavity contained a large quantity of fluid of the makroscopic and microscopic characters of chyle. No coagula; only at lower ilium a few fibrinous deposits. Intestinal serosa and peritoneum of parietes thickened and opaque, and covered by numerous fibrinous bands, which connect the intestinal convolutions with each other and with the mesentery and abdominal walls. Here and there these bands were infiltrated with chylous fluid, and consequently milky and opaque; especially striking was this condition upon the walls of the small intestines. About 2 or 3 metres above the ileo-cæcal valve commenced a very dense injection of the chyle-vessels, extending to the duodenum, with a perfectly chyle-like milk-white mass. The chyle vessels were dilated, regular and irregular, and alongside of them were larger, rounded, slightly prominent milk-white spots, representing extravasations. No fluid flowed from the cut surface of the mass, nor from the vessels; the contents were coagulated. Chyle retention was also found upon the swelled mucosa of the entire small intestines in a marked degree, and also in the submucosa. In the latter was found an accumulation of chyle spots, and in the lower portion of the ileum the chyle could be seen in minute white clots. The chyle vessels were injected exactly to the union of the intestines with the mesentery; not injected in the latter; mesenteric glands small, without chyle retention." "Nothing abnormal found in the thoracic duct. The obstruction to the flow of the chyle was

caused by inflammatory thickening of both folds of the mesentery and the transformation of the interposed adipose tissue into tense connective tissue, and the adhesions upon the surface which united the numerous folds of the mesentery to each other.” “Liver closely united to the diaphragm, enlarged. Under the microscope the liver cells were distinct, but loosely imbedded in the trabeculæ, and filled with minute fat globules. Spleen slightly enlarged. Supra-renal capsules softened; kidneys small; surface smooth; capsule easily detached; fat drops in the glomeruli and epithelium of the tubules. Stomach and larger intestines normal. Contents bilious. Pancreas very small.”

*Case 44.*—Effusion of Chyle into right pleural cavity.\* “C. S., æt. 50, male, dissipated, previous health good. Was run over by a wagon whilst lying partly upon the right side and abdomen. Eleven days afterwards, was admitted to hospital on account of pleuritic effusion. Superficial lesions and bruises healing. 7th and 9th ribs broken anteriorly in the axillary line. Dyspnoea set in on the third day after the accident, and increased from day to day until the tenth day after admission, when 1800 cm. of fluid were withdrawn. The fluid was of a whitish yellow color, had the appearance of milk, and after standing presented upon its surface a white layer of cream of the thickness of a millimetre. It exhibited under the microscope minute fat globules. Subsequently, after the disappearance of all the symptoms of the hydro-pneumothorax, œdema supervened, radiating from the puncture, and extending over the entire right side of the trunk and to the middle of the thigh. After puncture a milky fluid flowed guttatim from the œdematous part, at the rate of 100 cm. per hour. The fluid reaccumulated in the pleural cavity, and during the third tapping the patient expired.”

*Sectio cadaveris* by Prof. Langhaus. “Upon right side of thorax moderate infiltration of cellular tissue and muscles with nearly clear fluid. Diaphragm of left side as high as 5th intercostal space; of right side convexed and bulging downward. Right pleural cavity contained 7000 ctm. of a milky whitish-yellow fluid; pleura transparent, no injection anywhere; no discoloration or thickening. Towards the mediastinum milk-white deposits, easily removed; most copious upon the

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\* Quincke, *Deutsch. Archiv. fur Klinisch. Medicin.*, 1875, Bd. xvi., p. 121. Leipzig.



upper portion and at the apex of the pleural cavity. Sub-pleural cellular tissue at sternal end of first rib and the adjacent part of sternum contained a white milky fluid, but no lesion of the pleura could be found in that region. This limited extravasation did not extend to the thoracic duct. The duct, from its mouth to the point of emergence from behind right subclavian, was filled with coagulated blood. The lower portion could not be dissected out. Left pleural cavity contained 100 cm. of nearly clear serous fluid. Sixth, seventh and eighth left ribs broken in axillary line. Right lung compressed, atelectatic, without other changes; ribbon-like adhesions with lateral thoracic walls. Heart, liver and kidneys normal. In spleen small coagulated hemorrhagic spots. Mesentery and mucous membrane of intestines without chyle. In pelvic cavity and between intestinal convolutions a small quantity of a whitish fluid. Chemical examination of fluid proved it to be animal chyle.

Aspiration.	Day of Injury.	Quantity.	Specific Gravity.	Fatty Matter.
I.....	10	1800 ctms.	1020	1.092
II.....	19	3000 "	1017	1.263
III.....	21	1000 "	1016	1.078
Pleural contents.		7000 "	1016	
Fluid œdema...	14	100 in one hour.	1019	

No. I., deprived of albumen, reduced CuO in alkaline solution upon boiling; not during rest at a low temperature. No. II did not reduce CuO upon boiling."

Quinke claims this to be a case of rupture of a chyle vessel, most probably the thoracic duct in the pleural cavity. The character of the fluid, its repeated reproduction with nearly identical properties, leave no doubt of the presence of chyle.

*Case 45.*—Chylous ascites caused by parasites—*hæmatozoa*.\* The widow of a missionary, aged 39, who had resided ten years in Surinam, observed, a year after returning home (1872), increased tension of the abdominal walls and the protrusion of a tumor from the vulva. The vulvar tumor consisted of a cystocele and incomplete prolapsus uteri, caused by the pressure of the chylous effusion in the peritoneal cavity. After a course of ineffectual medication, which was assiduously prosecuted until September 1874, she was tapped, and two litres of a buttermilk fluid was evacuated. Under the microscope this fluid exhibited "an

\* F. Winckel, *Deutsch Archiv. f. Klinisch. Med.*, 1876., Bd. 17, p. 303.

enormous number of small filiform entozoa in very active serpentine and whipping motion, each with a rounded head, a sharply-pointed tail, and upon the head 4 to 5 cilia, by means of which they appeared to obtain nutriment from the surrounding parts." In some was observed a central tube extending from the head to the tail. They were 0.01 mm. in width and 0.2 mm. in length.\* "After the tapping the patient recuperated, but soon there followed a swelling of the left leg similar to a phlegmasia alba dolens, and equally tense and painful; urine was normal in color and specific gravity, did not contain any albumen. No tumor could be recognized in the abdominal cavity. The liver, kidneys, and spleen seemed normal. No fever at any time, but the patient sometimes felt cool and presented moderate appearances of anæmia. The swelling of the leg gradually subsided, but a pain in the veins near the groin remained for some time." She continued in fair health until the summer of 1875, when there was a slight return of the ascites. From this time it continued to increase, and in August, 1876, she was again tapped, 19 quarts of a similar fluid being evacuated; but the relief was only partial, and two days afterwards, during an attempt at defecation, she was suddenly seized with a violent pain in the abdomen and expired in great agony in 30 minutes. Previous to the last tapping the right pleural cavity "showed exudation without previous pleuritic symptoms."†

Of this series of cases, there were six instances of effusion of a chylous fluid into one or both pleural cavities. In three of these cases the fluid poured directly from the thoracic duct, in one of which (Bassius) the aperture in the walls of the duct was discovered after death, and in the other two (cases of Guiffart and Quinke), the rupture was the result of external violence. It is not, however, certain that the vent which emitted the fluid in Quinke's case was in the duct. In Curling's case (No. 34), the lymph concretion which occupied the right pleural cavity was discovered in the body of a patient, whose right lower extremity had been amputated at the hip joint, two months previous to death, for malignant disease of the thigh. In the cases

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\* "I showed specimens to Drs. Osterloh, Kruger, Franke, Fehrmann, Lobeck, Virchow, Leisering and others, and all responded to the question, What are these entozoa? the ready answer, 'Nescio.' "—Winckel, p. 304.

† Winckel refers to a statement made by the patient, that physicians in Surinam characterized her case as nothing unusual, and related a case from which "two casks full" of a similar fluid was evacuated.

of Rokitansky and Ormerod (No. 37 and 40), the chylous fluid was effused into the pleural and peritoneal cavities; in the former in consequence of obstructed heart circulation, and in the latter as the result of the interruption of the blood current in the left subclavian vein. These cases, with those of Hoffmann and Bonet (30 and 31), furnish eight instances of lesions, produced by accident or disease, either in the duct or some of its larger affluent branches, in or about the thorax, sufficient to emit the fluid in quantities incompatible with vigorous health, and certainly endangering life if not causing death; whereas among the cases of chylous ascites there was but one (42), and probably a second (Poncy's), in which the chylous fluid found its outlet through an aperture in the walls of the thoracic duct. With the exception of the cases of Rokitansky and Ormerod all the cases belong to a class of casualties, which do not admit of any generalization, and are only instructive in suggesting the occurrence of an improbable contingency which may happen under circumstances very various and unforeseen. In both of the cases reported by Quincke (43 and 44), there was found, both in the pleural and peritoneal cavities, chylous fluid, though the post mortem examinations determined the cases as one of effusion into the pleural cavity (44), and the other of chylous ascites (43). In both cases the anatomical lesions were clearly made out; in 44 the laceration of the duct permitted the escape of the chyle into the pleural cavity, and in case 43 chyle retention was caused by an inflammatory thickening of both folds of the mesentery, by which the lacteals were narrowed or completely occluded. The lymphatic glands were small and free from chyle retention, but the chyle vessels were "injected exactly to the union of the intestine with the mesentery." The flow of chyle was obstructed, engorgement of the vessels ensued, rupture occurred, and the fluid poured into the peritoneal cavity. But how explain the presence of chyle in the peritoneal cavity in case 43, and in the pleural cavity in case 44? In both instances the phenomenon is, perhaps, partially explicable upon the supposition that portions of the effused fluid traversed the lymph vessels of the diaphragm, but in the case of laceration of the duct within the thorax, it is possible that stasis of chyle ensued in the abdominal portion of the duct, in consequence of the loss of the influence of the suction power of the heart upon the movement of the contents of the thoracic duct.

This latter view is, however, negatived by the absence of chyle retention in the chyle vessels of the mesentery and intestines.

Of the 18 cases of chylous ascites, in two (22 and 39) the orifice through which the fluid was discharged was found in the walls of the receptaculum chyli;\* in 39 the rupture occurred in consequence of stenosis of the thoracic duct near its outlet, and in 22 from ossification of the wall of the receptaculum and filling of its cavity with "bony concretions." In 5 cases (25, 26, 27, 28 and 43), and probably in cases 37 and 40, the rupture took place in the chyle vessels of the mesentery. In 4 of these cases (26, 27, 28 and 40), and in the cases of Abell, Hoppe-Seyler and Wilhelm (33, 38 and 42), in which no post mortem examination was had, abdominal tumors were discovered either by inspection of the cadavers, or by palpation during life, and the probability is that the rupture was the result of compression, either of the thoracic duct, which in some of the cases was very much dilated, or of the lacteal vessels. In two other instances the duct was compressed by tumors situated in the thorax, near its entrance into the left subclavian vein. These tumors were usually glandular, and consisted of hypertrophied and degenerated lymph or mesenteric glands, co-existing in two cases with an enlarged liver, and in two other instances with cancerous formations.† In a single instance (45) the ascites was ascribed to the presence of a parasite in the lymph vessels, which was first discovered by Lewis in his investigations into the nature and cause of chyluria, and which he believes penetrates the walls of lymph vessels, thus establishing apertures through which the contents are discharged into the bladder in cases of chyluria, and, as is supposed to have occurred in Winckel's case, into the peritoneal cavity in cases of chylous ascites. It is not, however, necessary to assume the presence of the *filiaria* in 16 of the 18 cases of chylous ascites previously cited; for in all of them, excepting the cases of Monro (24) and Winckel (45), conditions were present which satisfactorily explain the occurrence of the effusion of a

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\* Hasse (Path. Anat. Syd. Soc. Ed., p. 10) refers to a case of dilatation of the receptaculum, observed by Rokitsansky, and another by Albers, but the references cannot be verified.

† Mascagni and Soemmerring observed dilatation of lymphatics about cancerous tumors. Lebert has many times observed the lymphatics of the mesentery dilated, sometimes filled with cancerous matter, sometimes simply dilated by stagnation and by an obstacle to the circulation of the lymph or chyle. Loc. cit.

chylous fluid. It is, nevertheless, worthy of notice that in Winckel's case, in which the "filiform entozoa" were discovered, there was a co-existing condition of the left lower extremity similar to phlegmasia alba dolens, and in Quincke's case of peritoneal dropsy (43), in which the chyle retention was satisfactorily accounted for by the condition of the mesentery, previously described, there was also present an œdematous condition of the right leg and forearm and elephantiac formation, which was, presumably, due to disturbances of the lymphatic circulation of the parts thus affected. In Chevalier's case,\* the enormous elephantiac development of the right lower extremity followed an attack of phlegmasia alba dolens, and in a number of cases of lymphorrhœa similar developments have supervened, both in the immediate vicinity of the fistulæ, and in parts remote from the cutaneous apertures. Unfortunately Winckel lost the opportunity of studying the connection of these parasites with the co-existing disturbances of the lymph circulation so markedly present in the limb of his patient, and, for the present, it and the analogous condition present in Quincke's case must be regarded as coincidences.

In 3 cases (35, 36 and 41) the chylous ascites was ascribed to obstructed pulmonary circulation; in 2 (37 and 40), to interrupted cardiac circulation, and in cases 26, 27 and 39 to obstructed chyle circulation in consequence of stenosis of the thoracic duct at or near its entrance into the left subclavian. These, together with the cases of Worms and Oppolzer, and others to be introduced, present important considerations, relating especially to the influence of the cardiac and pulmonary circulation upon the movement of the chyle and lymph, which will be discussed further on.

From an anatomical stand-point, the cases of effusion of a chylous fluid into the serous cavities may be divided into three groups—chylous ascites, chylous hydrothorax, and chylous hydrocele; and in a pathological aspect into two classes—effusions of chyle, and effusions of a fatty fluid. To complete the anatomical groups, the cases, few in number, in which a chylous fluid has been found in the cavity of the tunica vaginalis testis, will be cited.

*Case† 46.*—"Galactoceles. G., of high stature, vigorous, and of

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\* See case No. ij., Amer. Jour. Obst., vol. x., p. 8.

† Aug. Vidal (de casis), *Traite de Pathologie externe*. etc. 5th ed., vol. v., 1861, p. 180.



bilio-sanguine temperament. His previous health had been perfect. His father died young with pleurisy, and mother of some uterine affection. Up to his fifteenth year he was a dyer; afterwards a soldier in Africa. He had several times contracted gonorrhœa, but without any affection of the scrotum, which had never been the seat of any lesion. The genital organs were normal. About eight months previous, while quietly in bed, he suffered from marked heaviness in the scrotum, and observed for the first time an enlargement, which finally became so large as to impede motion. The two tumors had the form of hydrocele; their lower and larger extremities equalled the fist of a child seven years old. There was no fluctuation; the position of the testicle could be easily made out by methodical pressure, but there was no transparency. The spermatic cords were healthy. His breasts were like those of men generally. His food had always been animal; he drank but little milk, but much wine, though not to excess. His virility was perfect and decided. After the puncture and evacuation of a milky fluid, it was discovered that the testicles were under size, though the penis was in size corresponding to the age of the patient. There was no enlargement of the prostate or vesiculæ seminales. Analysis of the fluid by M. Grassi: Water; a substance differing from albumen, but very analogous to it, if not identical with casein; a fatty body presenting the physical characteristics of butter; sugar, chloride of sodium, traces of lime, probably the chloride. The fluid was alkaline and coagulated spontaneously. Examined under the microscope with a high power, there was seen a multitude of very small transparent globules, some spherical, others irregular, but all having the appearance of globules of butter. Boiling did not produce coagulation, as is ordinarily the case with hydrocele fluid.\*

*Case 47.*—"Hydrocele, with contents simulating chylous urine. C., æt. 25, potmaker, admitted November 9th, with hydrocele of the right tunica vaginalis of the size of a large orange; stated to

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\* Vidal refers to the case which Lebert observed in the clinic of Schonlein at Zurich, in 1833, as analogous, but it more properly belongs to the cases denominated by Manson "lymph scrotum," and will be referred to under that heading. He also refers to a case of milky tumor in the breast of a man observed by Velpeau, and to a butyric tumor in the superior maxillary, observed by Marionneuve. See Sichel's letter and the synopsis of Lebert, *La Lancette Française*, Gaz. d. Hôpitaux civils et Militaires, No. 127, T. x. 2d series, p. 508. 1848.

† T. Ruthnum, Madras Quar. Jour. Med. Sci., 1862-3, p. 421.

have reappeared after an operation 20 days previously, which was followed by an injection of equal parts of tinct. iodini and water."

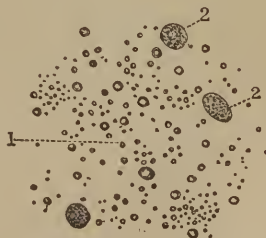
"Contents were of the color of milk, with a greenish yellow tinge, thick, and measuring 13 oz. in amount. Coagulated spontaneously. No pus or mucus found. Cured by injection of iodine."

*Case\* 48.*—Case of milky fluid from the tunica vaginalis. Galactoceles. "The fluid exhibited presented all the physical characters of ordinary milk, and was obtained by tapping from the tunica vaginalis. The patient was a German, æt. 42, a healthy looking man. He had been thrice tapped within the last twelve months, and a similar fluid had been drawn off on each occasion. In all its external characters and in its history, the case resembled ordinary hydrocele. Fluctuation was so palpable that no examination to ascertain transparency was made. The fluid was alkaline, had a specific gravity of 1019, so closely resembled milk as to be undistinguishable from it by the naked eye, and emitted a peculiar odor, due to sulphuretted hydrogen—the result of partial decomposition. The milky appearance was due to the presence of fat, which having been dissolved by ether left the liquid transparent, resembling ordinary hydrocele fluid. Heat and nitric acid caused a copious deposit of albumen, and the aqueous part contained sugar, and a protein substance resembling casein in its reaction. The inorganic ingredients consisted of lime, soda, and potash in combination with phosphoric, sulphuric and hydrochloric acids."

"The specimen, when first examined microscopically,† consisted of a colorless fluid, in which floated many very small globules, resembling milk globules but smaller (see 1, fig. 20). A number of minute granules and a few large cells filled with oily particles (see 2, fig. 20), not unlike colostrum corpuscles."

"Upon the surface of a portion of the fluid a month old a curd formed, somewhat like cream, but

[Figure 20.]

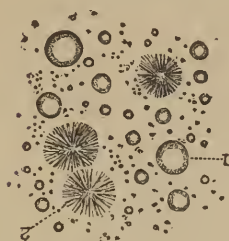


\* Ferguson, Trans. Path. Soc. Lond., vol. xvi., p. 184, 1865, Meeting Dec. 6th, 1864.

† Synopsis of report of Dr. Geo. Harley and Mr. Francis Mason.

too pale and deficient in fatty matter. The scanty deposit consisted of some very large oil globules (see 1, fig. 21), and scattered

[Figure 21.]



stellate crystals of margaric acid (see 2, fig. 21). Spermatic filaments were carefully looked for, but none were detected. The lactescent and the ordinary hydrocele fluid differed but little except in the presence of oleaginous matter in the former. By removing the fatty matter from the milky fluid, it assumed the appearance of the other, and by adding animal oil to the ordinary hydrocele fluid it became lactescent."

*Case\* 49.*—"Chylocele. W. H. W., a native of Mobile, Ala., aged 22 years; five feet and eleven inches in height; 157 pounds in weight; robust in health; of a bilious temperament; black hair and eyes; dark complexion; presented for treatment October 18th, 1874. He had had hydrocele, and gave the following history of his case: Some eight years ago he had first discovered an enlargement of his scrotum, which slowly increased in size, causing him to seek medical advice; but it was not until four years after that date that he was tapped, and a quantity of 'white fluid' drawn off; then again the sack rapidly refilled, and on three several occasions he resorted to the same operation." "No relief being obtained, he came to consult me. Thinking I was to deal with an ordinary case of hydrocele, I introduced a trocar, and drew off eight ounces of a thick white fluid having all the appearance of milk. The sac was dense, firm and elastic, presenting all the density of the ball of an ordinary Davidson's syringe when the ball is empty; the testicle was slightly enlarged, yet no appearance of any disease of the gland itself."

"I submitted the fluid for examination to Dr. James Tyson—the following is the result of his examination." "The fluid is alkaline in reaction; S. P. G. 1.015, highly albuminous, and to be made up, as determined by the microscope, of innumerable molecules, which are mere points under power of 400 diameters, together with a limited number of small granular cells somewhat smaller, but otherwise resembling the colorless corpuscles of the blood floating in a serous fluid. Its physical characters are precisely those of chyle; chemically I find it almost completely

\* C. H. Mastin, Amer. Med. Weekly, Louisville, Ky., vol. ii., p. 617.

dissolved by ether, and after evaporation of the latter to leave a cream-like mass. There were no spermatozoids. The fluid is not only in its physical but in its chemical characters comparable to chyle, and I believe its origin to be similar to that of chylous urine, so called, which is probably due to the leakage of a lymph vessel in the bladder. \* \* \* Our fluid was not examined for sugar, but even with sugar present, I should compare the fluid with lymph or chyle rather than milk, for it contains: (1) the molecular base with very few oil (milk) globules; (2) the leucocytes or chyle corpuscles; (3) the albumen."

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"Very sincerely yours,

"JAMES TYSON.

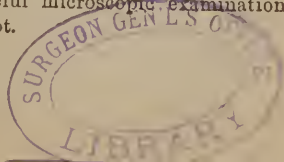
October 24th, 1874.

"After my first operation (October 18th, 1874) I did not see the patient until April, 1875, and on the 5th operated by making an incision through the integuments down on the tunica vaginalis. I evacuated eight ounces of the same kind of fluid which had been discharged by my first operation. I now opened the sac freely for the distance of two to three inches. I found it very much thickened, dense in structure, hard, firm, and about four millimetres in thickness. Examining carefully the cavity, I found it smooth, polished, and pearly white; at its upper portion just where it begins to be reflected over the testis, I discovered a small, round, granular-looking mass about the size of an ordinary English pea; this I sliced\* off with a pair of scissors, and at once recognized the patulous mouths of three or four small vessels (vessels which did not bleed), and which, from all appearances to the naked eye, I believe were the mouths of lymphatics."

"I dissected them back for a short distance, to see whether they communicated with either the cord or the gland, but found they passed into the cellular tissue around the upper portion of the testis."

"I concluded to tie the bundle *en masse*, with a small and very strong silk ligature, so as to shut off communication from the tunica vaginalis, and then bring the ends of the ligature to the outside. I then carefully excised all the front wall of the tunica, and with four or five delicate silk sutures coaptated the edges of the sac, so as to close up the cavity, leaving one end of each

\* Unfortunately this "mass" was lost. A careful microscopic examination would have determined its nature beyond any doubt.



All after p. 84 missing







